JAN. 25

POPULAR SCIENCE

MONTHLY



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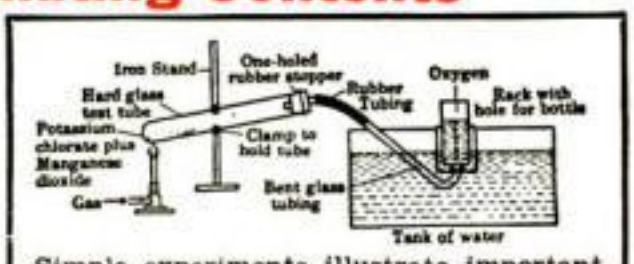
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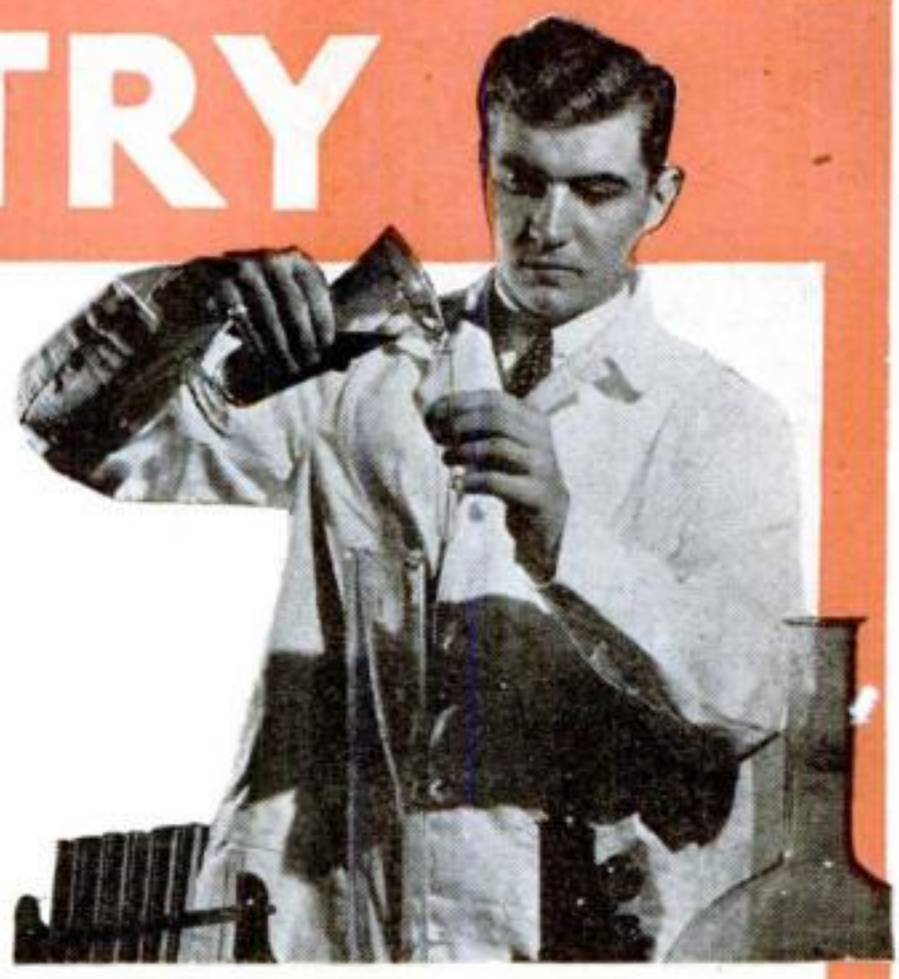
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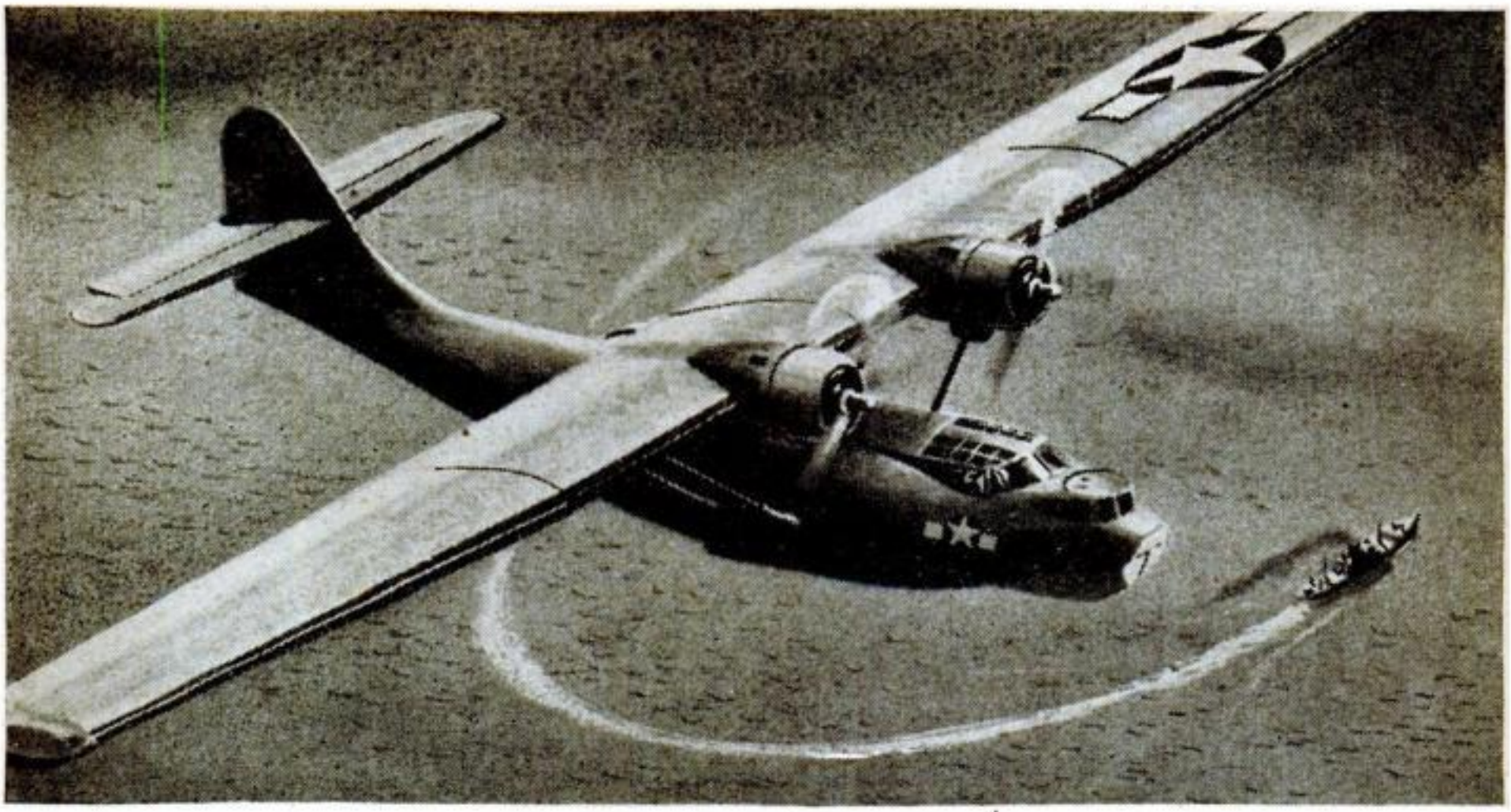
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She was retired by everyone but the men who flew her!

In their hands she was driving the Nazi subs away from the sea lanes to Great Britain. She was helping to sink the "Bismarck." She was flashing the report that began the Battle of Midway. She was mauling the Jap in the Aleutians. She was rescuing pilots and crews all over the vast Pacific. She was deviling Jap shipping to a virtual extinction. Just recently, in fact, a "Cat" sank 4 Jap ships on a single flight!

No, the Catalina isn't ready to retire yet.

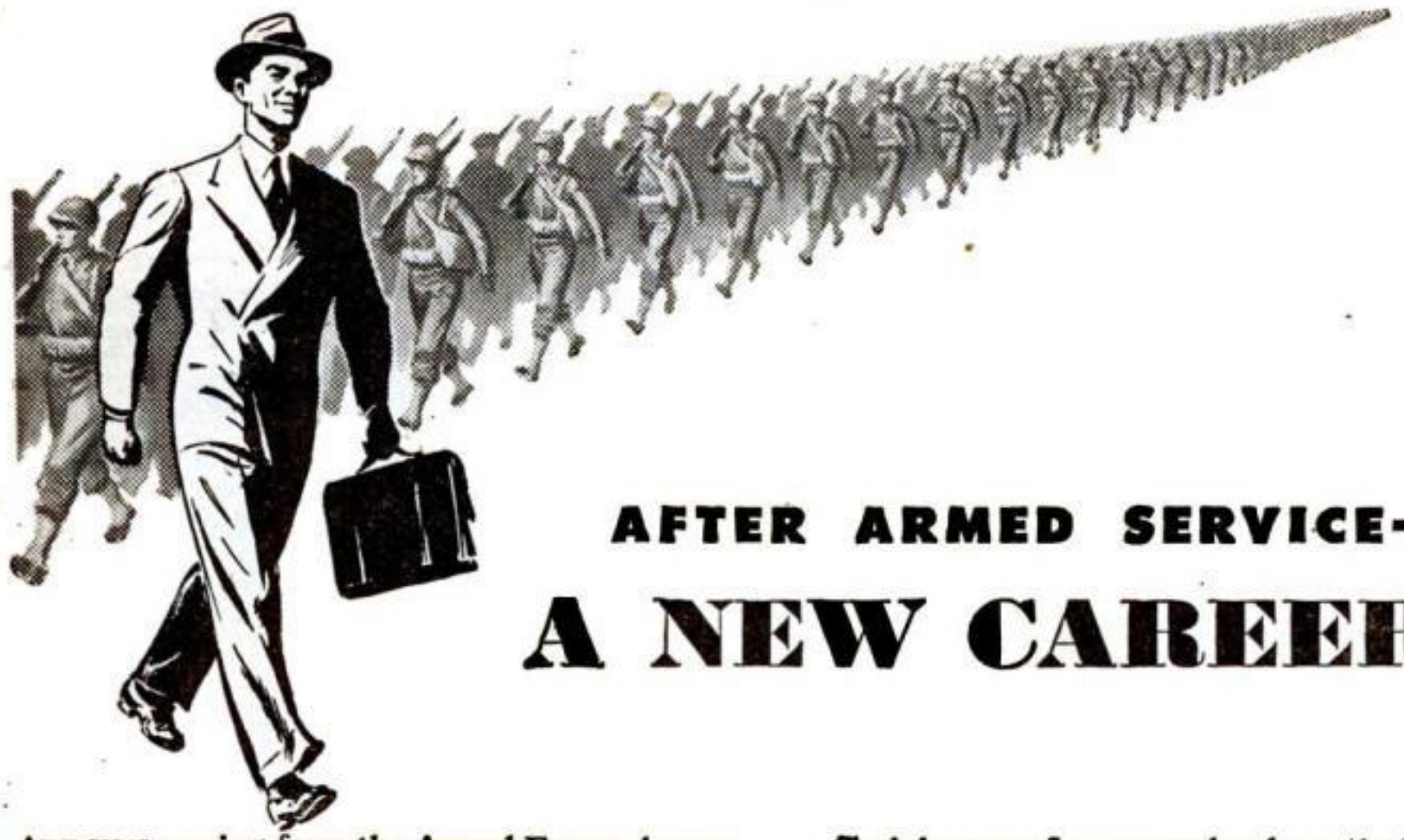
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Popular Science Monthly for January, 1945, Volume 146, Number 1, Published monthly at 353 Fourth Avenue, New York 10, N. Y. by Popular Science Publishing Co., Inc. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Yearly subscriptions to the United States, $2.50.

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Mechanics & Handicraft

A TECHNICAL JOURNAL OF SCIENCE AND INDUSTRY

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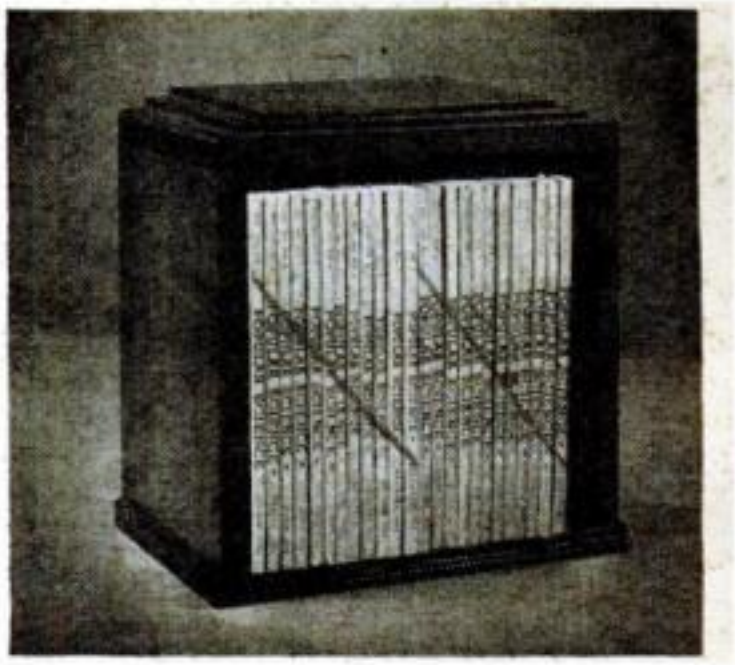
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THAT RED STRIPE you see on the back of this copy of Popular Science Monthly is a new visual filing aid designed to help you keep your back numbers in order. As consecutive issues are stood or stacked together in proper sequence, the stripes will form an unbroken diagonal line for the 12 issues of a calendar year. You can see at a glance which issues are missing, and where to put one that is being replaced after use. (See page 138.)

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Published monthly at 353 Fourth Avenue, New York 10, N. Y., by Popular Science Publishing Co., Inc. Godfrey Hammond, President and Treasurer; R. C. Wilson, Raymond J. Brown, Charles McLendon, Stephen P. Glennon, Vice-Presidents; F. W. Briggs, Secretary. Entered as second-class matter Dec. 28, 1918, at the Post Office at New York under the act of March 3, 1879; additional entry as second-class matter at Dayton, Ohio. Entered as second-class matter at the Post Office Department, Canada. Printed in U.S.A.

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RESEARCH, in the Bell Telephone System, has always been an expanding activity, growing with the scientific knowledge of the times and contributing to that knowledge.

The telephone, itself, was invented in the laboratory where Alexander Graham Bell was carrying on researches in speech and hearing and laying the foundation for the electrical transmission of speech. As time went on the telephone research program expanded to cover every science which gives any promise of improved telephony.

These researches and development studies now include electrical communication of speech—both by wire and by radio—the transmission of pictures (television)—and many important projects for war.

There Is No End to Progress

Every new research gives rise to new inventions and to new lines for development and design. New inventions indicate new lines for more research. In the early years, this work was carried in part by the American Telephone and Telegraph Company and in part by the Western Electric Company, the manufacturing unit of the Bell System.

For many years, however, the work has been assigned to a specialized unit, Bell Telephone Laboratories, Incorporated. Theirs is the responsibility for the technical future of the telephone industry.

The policies and procedures of Bell Telephone Laboratories are distinguished by two characteristics. In the first place the Laboratories design for service. The consideration is not the profit of a manufacturer, but the production of equipment which will give the best service at the lowest annual cost when all factors are considered, such as first cost, maintenance, operation, and obsolescence. The Laboratories make no profit and the equipment they design is owned and used by the telephone companies; and the emphasis is upon that use.

Organized Co-ordinated Research

In the second place the Laboratories design always with reference to the complete communication system in which the equipment is to play a part.

Reliable, economical telephone service, which is the product of its efforts, is not so much an assemblage of excellent apparatus as it is an excellent assembly of co-ordinated equipment—all designed to work together.

4600 People in Bell Laboratories

Bell Laboratories contributions to the Armed Forces derive in large part from the technical background that the Laboratories had acquired through their steadily maintained program of research. The Laboratories had special knowledge and skill which could instantly be diverted to war problems.

At the time of Pearl Harbor, over a quarter of the 4600 people in the Laboratories had twenty or more years of service. This breadth of background made possible many engineering developments outside the strict field of communication and these have been of value to the Armed Forces. So far the Armed Forces and the O.S.R.D. have engaged the Laboratories on over a thousand major projects.

Most of the Laboratories developments, of course, have been in the field of electrical communication. Communication, not simply between individuals as in ordinary telephony, but also between mechanisms, as in the electrical gun director.

Leader in Electronic Development

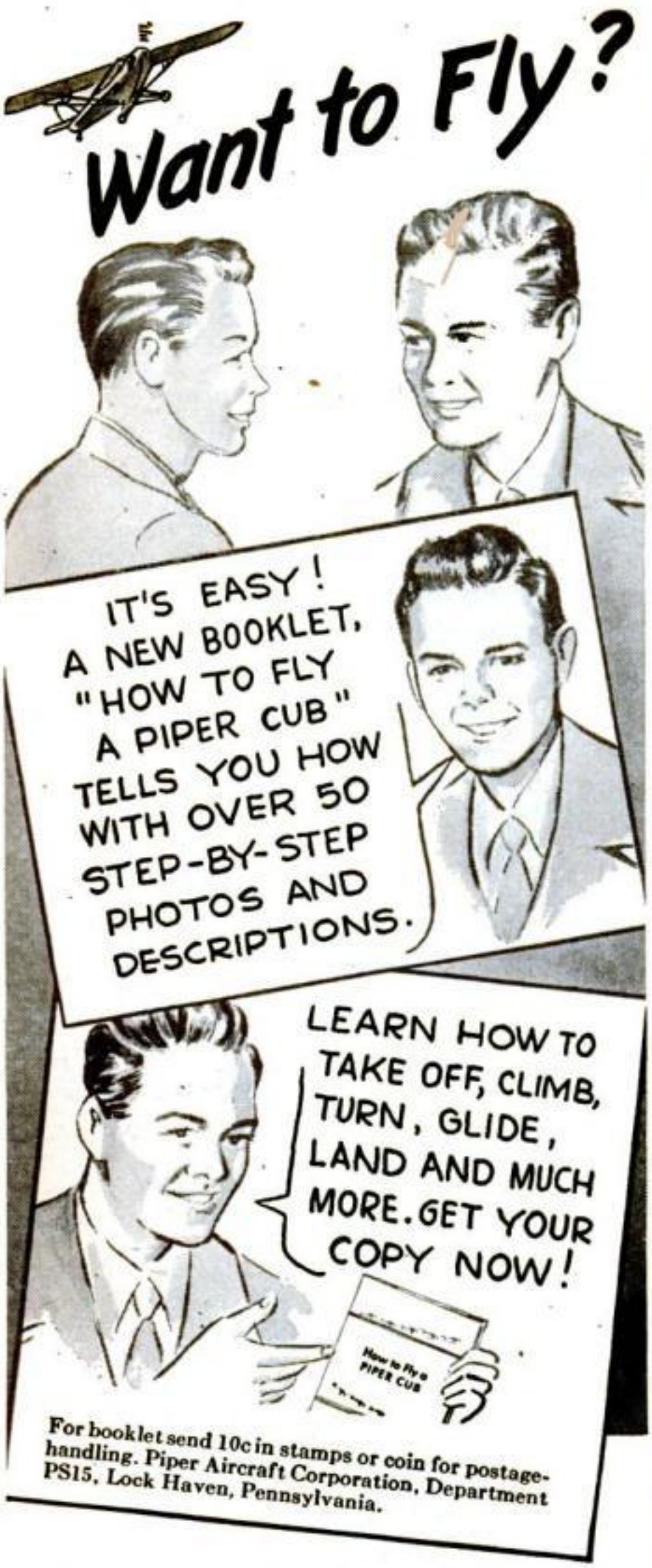
The Laboratories techniques and electronic researches have produced many secret weapons for our country's Armed Forces. In World War I, they pioneered by developing radio telephone systems for talking between planes and between planes and ground stations. They also contributed methods and devices for locating enemy planes, submarines, and artillery.

In this war, Bell Laboratories have pioneered in the field of electronics. The Western Electric Company, which manufactures the designs of the Laboratories, is the largest producer of electronic and other war communication equipment in the United States and is now engaged almost exclusively in the manufacture of this equipment.

In war, Bell Telephone Laboratories devote their work to the needs of our Armed Forces. In peace, they are constantly exploring and inventing, devising and perfecting for continued improvements and economies in telephone service. Centralized research is one of the reasons this country has always had "the most telephone service and the best at the least cost to the public."

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Coming Next Month

THE JAP NAVY is one of the enigmas of the war in the Pacific. Just how good would it be in a full-dress, showdown fight with our surface fleets? Are its vaunted secret superdreadnoughts a match for our mighty Iowa-class battlewagons? Alden P. Armagnac gives you an up-to-the-minute appraisal of Japanese seapower as the curtain rises on the last act of the battle for Asia.

HELLDIVER is the right name for the U. S. Navy's deadly new dive bomber. What about the men who pilot these fast, heavily armed, carrier-borne killers? What does it feel like to peel off from formation and hurtle down toward the deck of a Jap flat-top or battleship? A Helldiver pilot tells you all about it in a story that re-creates all the thrills and suspense of battle.

"GREEN GOLD" has been discovered in Wyoming! American prospectors are picking up fortunes in jade that rivals China's, and American craftsmen are carving it into beautiful jewelry and ornaments. Full-color photographs show this new source of mineral wealth and the artistic products made from it.

COLD-WEATHER STARTING needn't be a problem if you give your car a break. An article by Tom McCahill gives a lot of practical tips that will help to relieve the winter-morning crisis. You'll find several new stunts, besides the basic common-sense rules for cold-weather care of radiator, battery, and crankcase. A reading will pay dividends by saving your nerves and lengthening the life of your car.

PUTTING LIFE IN PHOTOGRAPHS is a specialty of Will Connell, top-notch commercial lensman whose work is sought by national advertising agencies and leading magazines. Some of the secrets of his art are revealed in an interview by Andrew R. Boone and illustrated with striking examples. Amateur photographers will get both inspiration and practical help from this account of a master workman's technique.

GEARS have been working for man since the days of the early Egyptians. But never before did they attain the precision and accuracy that is found in the parts made for modern aircraft engines. How these delicate cogs and pinions are formed is explained in text and pictures. In addition, you'll find some interesting facts on the design of gears and the terminology used by engineers in describing them.

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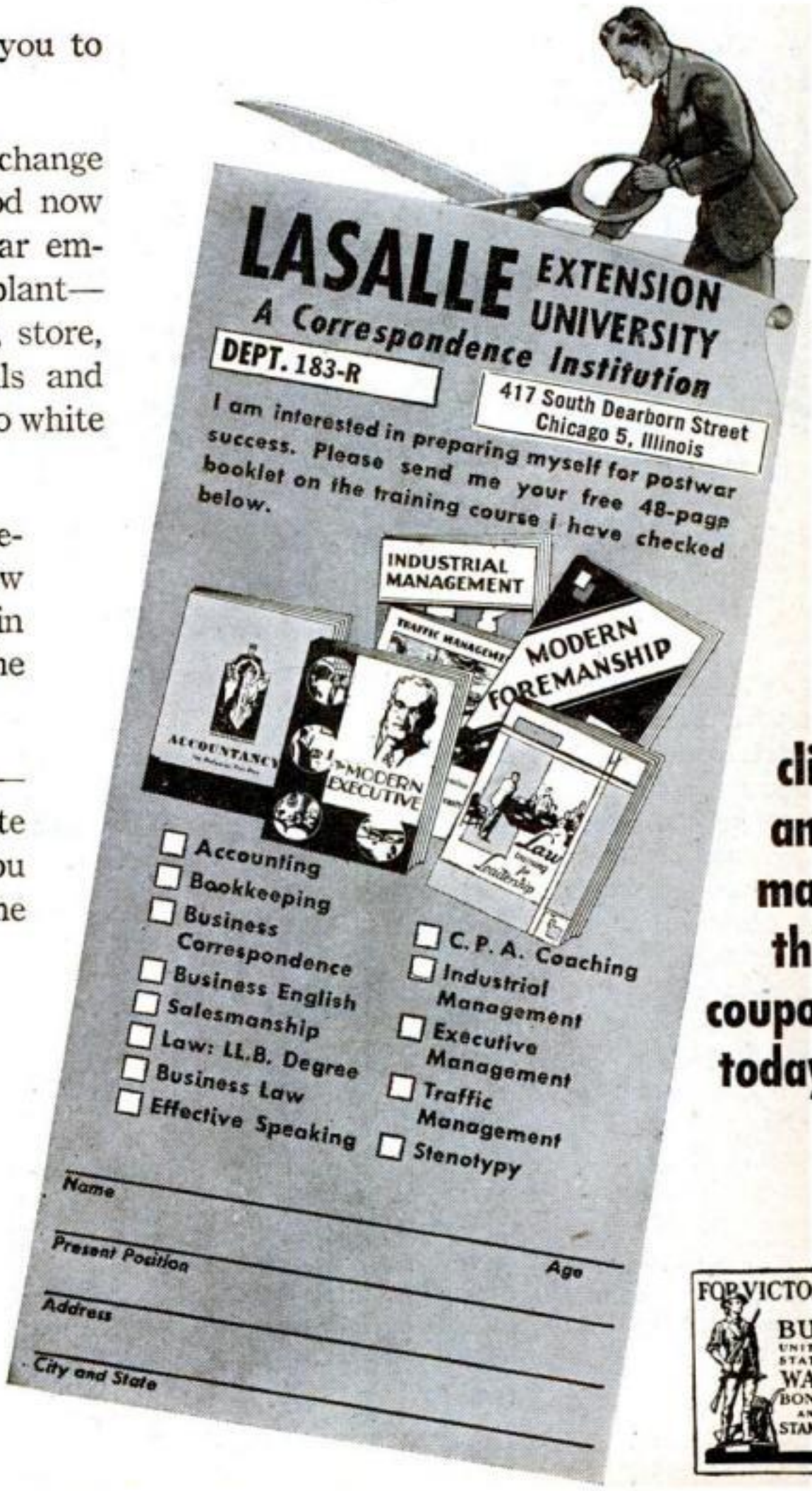
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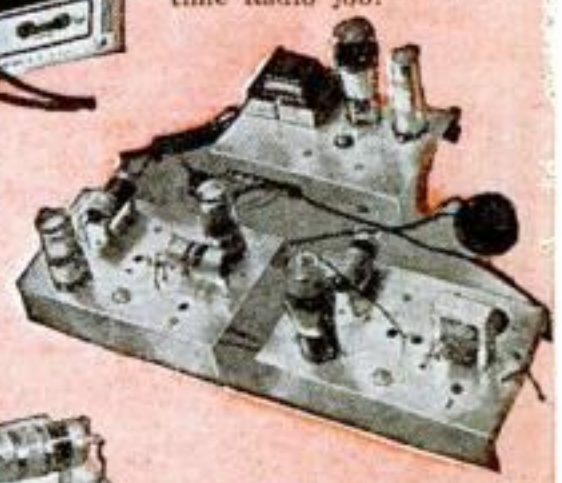
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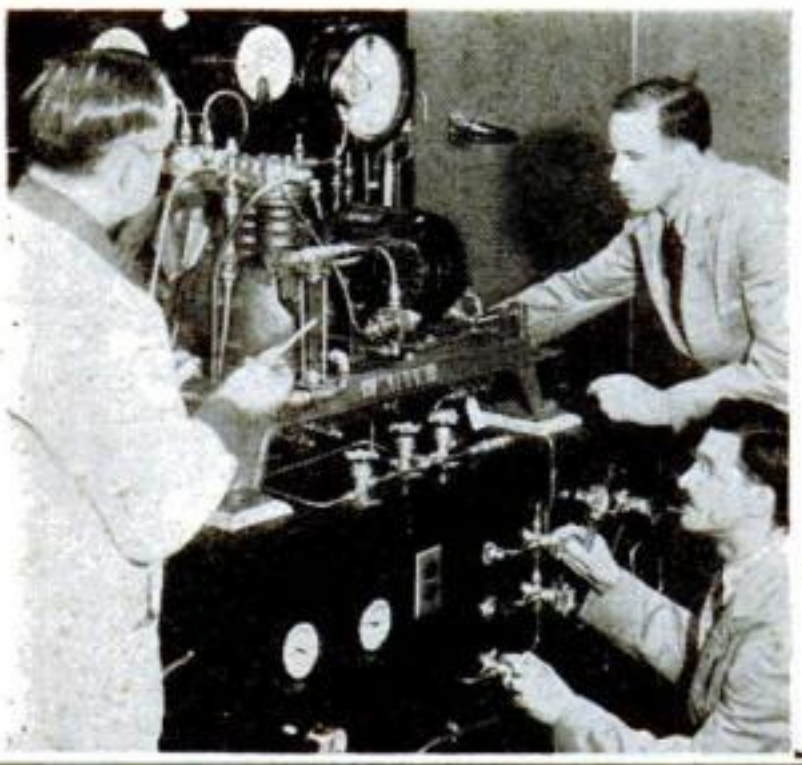
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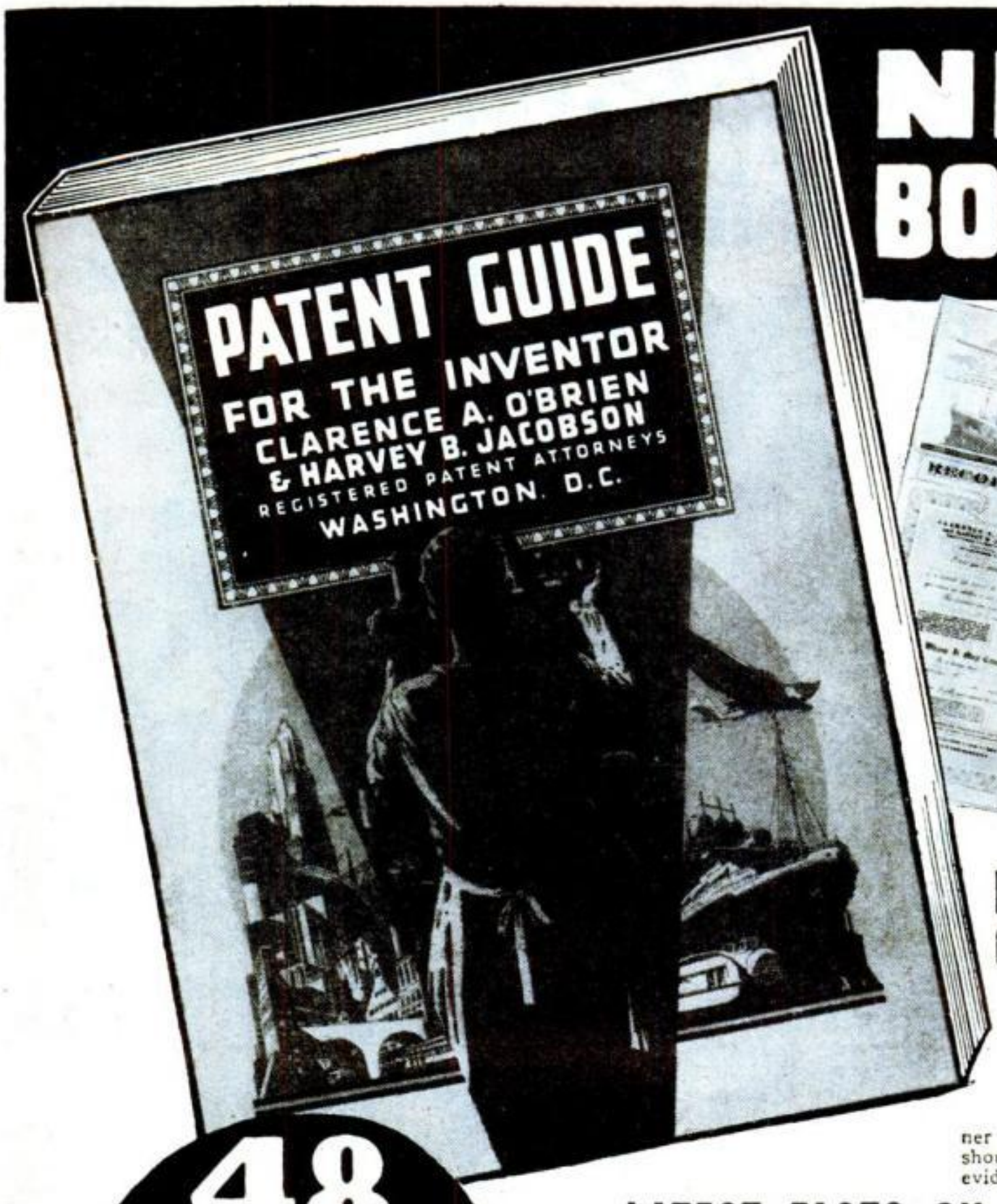
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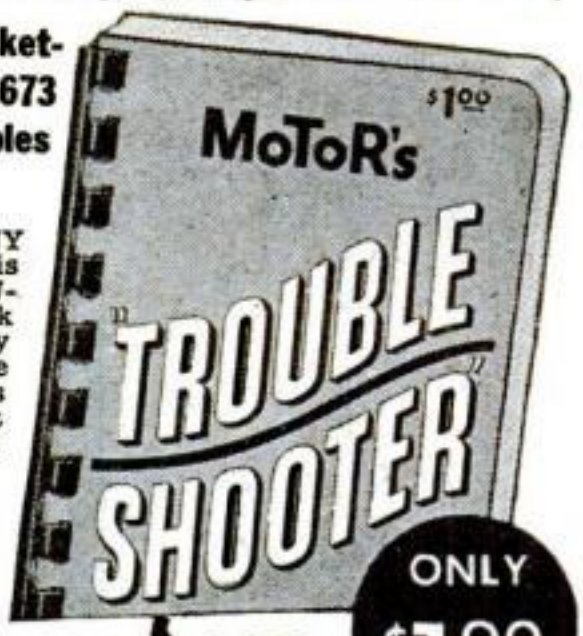
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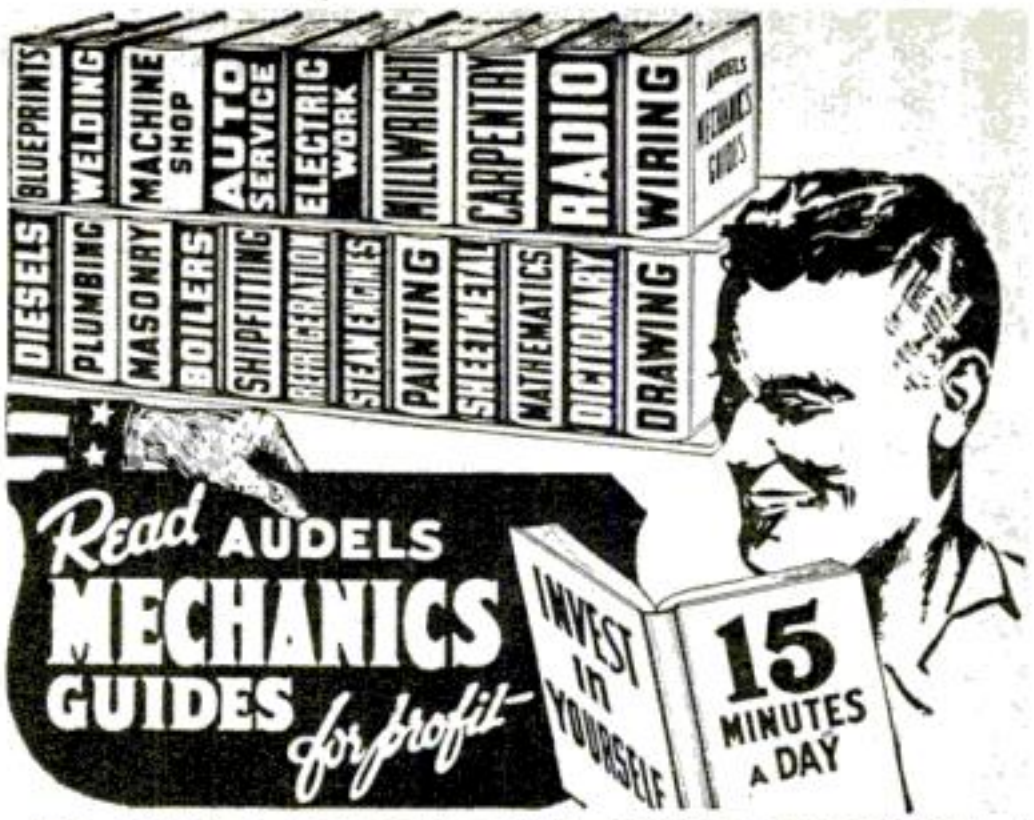
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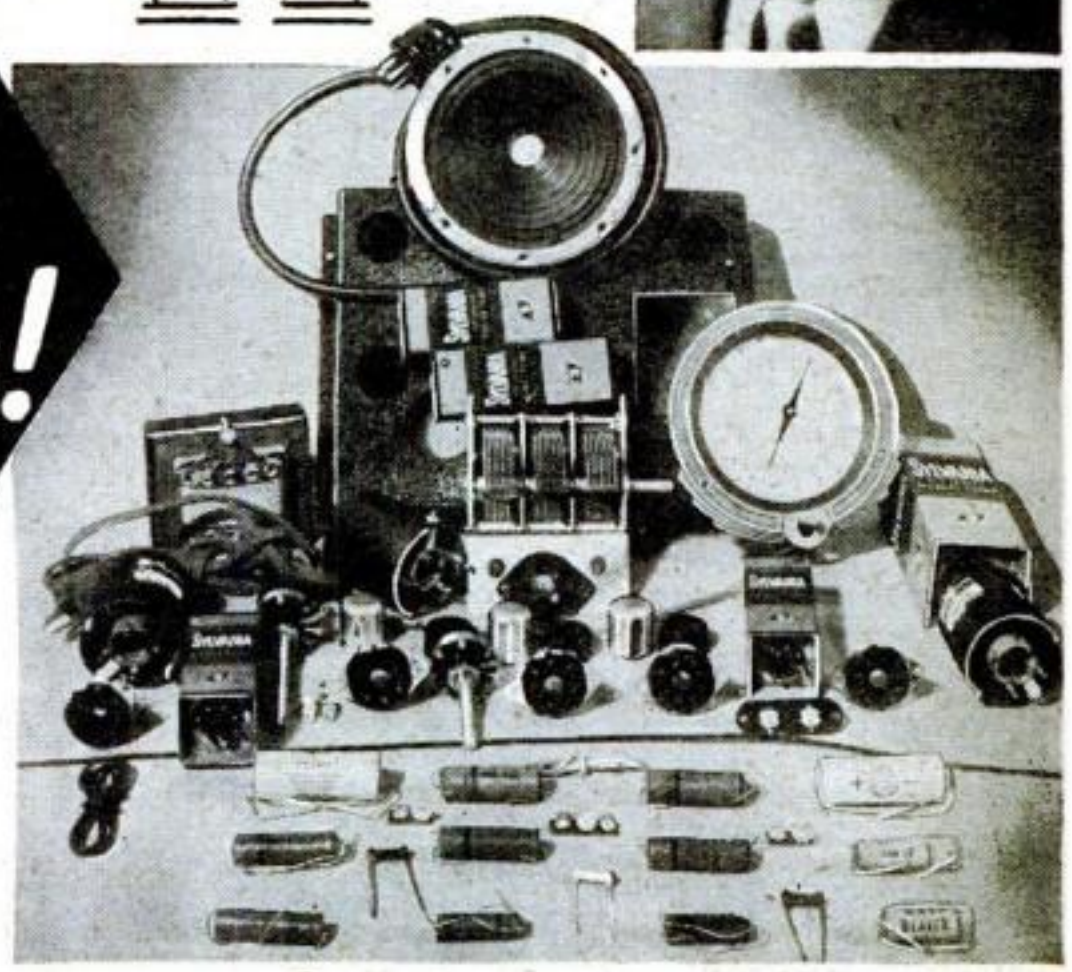


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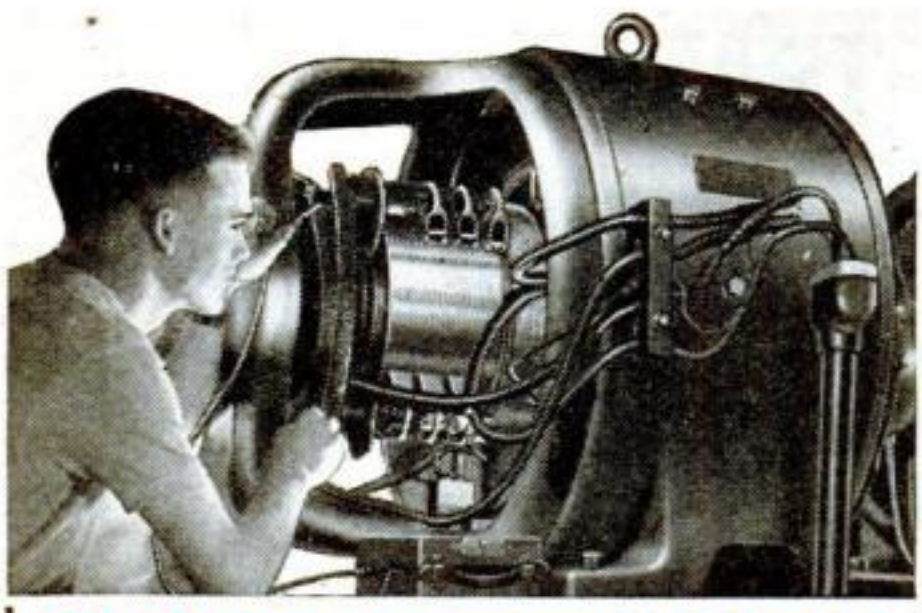
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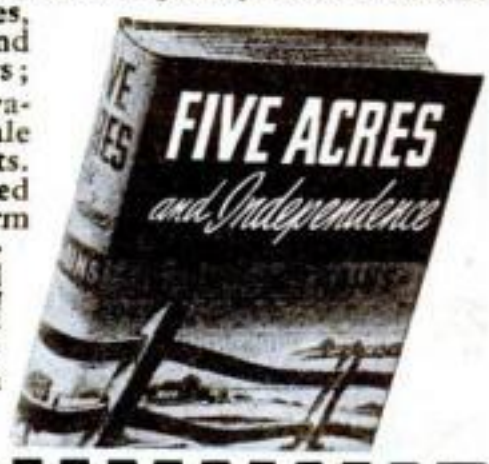
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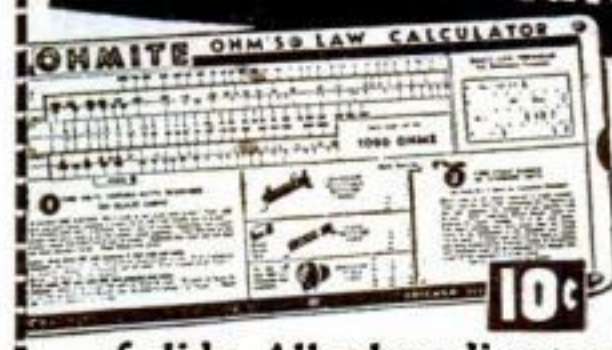
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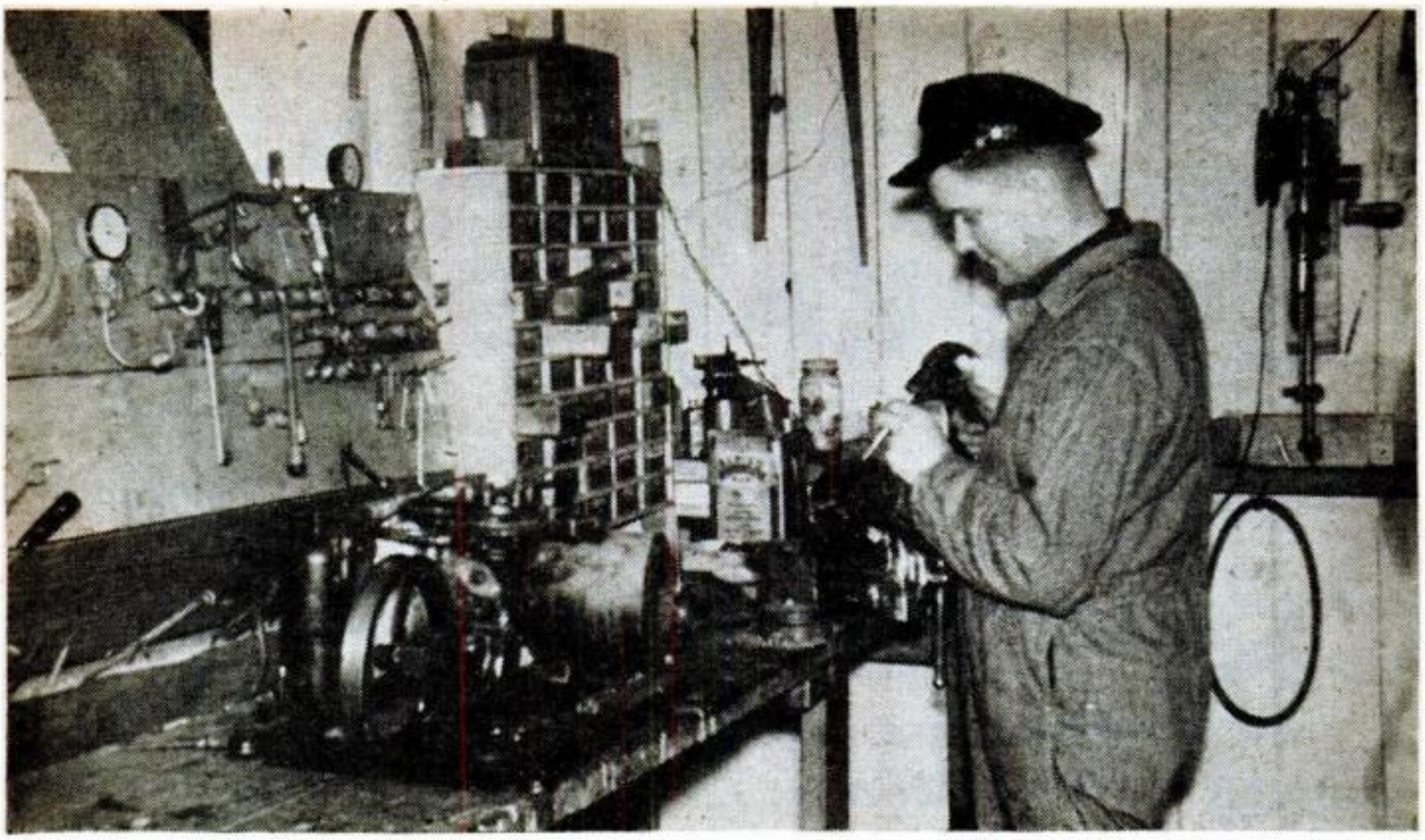
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This picture shows, among other things, the development that has taken place in land-shuffleboard cues in the last 21 years. The player contrasts the newest streamlined model (left) with the old type

Land Shuffleboard Reaches Maturity

DOWN here in St. Petersburg, Fla., we are celebrating the twenty-first birthday of the land version of deck shuffleboard. Since the game is one in which science figures as well as skill, it seems to me that P.S.M. should recognize its coming of age as a game that is not restricted to the deck of a ship.—G. W. V., St. Petersburg, Fla.

Put us down for a course of instruction in this apparently fascinating game the next time we visit St. Petersburg.—Ed.

Realist Crabs Pipe Dream About an LST Utopia

ONE reader of P.S.M. didn't have much to write or think about when he wrote in his notion about an LST making an ideal home after the war. I'm sure P. E. C., of Wrentham, Mass., has never had duty on one. I just thought I'd let him in on a few secrets. He will find that his new home will throw him out of his bunk every time the tide changes. Maybe our future home builder doesn't know it takes all hands and the

Readers Say:

ship's cook to beach one of the things. Those beautiful music-making sirens don't sound so good when they tell you of Jap planes and subs coming in to pay you a visit. If our great thinker likes coconut pulp so well, maybe I can arrange it with the Navy Department to bring him back a tank-deck load of the stuff. As for me, they can do anything they want to with the LST's so long as they don't make me take one as a gift. After serving 10 months on one, I definitely don't want one for any purpose. I'll read P.S.M. in the shade of a tree. I repeat—I don't want one. Brother, you can have 'em all.—J. D. E., S1/c., LST 18, EPO, San Francisco, Calif.

It's the old, old story. Just as your rich uncle is handing you a big wad of thousand-dollar bills, the alarm clock goes off. But it's fun to dream, isn't it! Suppose it does take all hands to beach an LST. If you're good enough to wangle one of these 300-foot boats, it should be no trick at all to get the 100 men necessary to handle it.—Ed.



Puzzled by Puzzle, Reader Says It Can't Be Done

IN YOUR October issue were some very interesting match puzzles. Puzzle No. 2, however, struck me as very remarkable. This was the one in which a wineglass was supported by three other wineglasses by the aid of three matches. In the solution to the puzzle I was dumbfounded to see three matches interlocked in such a manner as to have no support from each other, defying all laws of gravity. However, if anyone ever could accomplish this feat, I have no doubt that he could also support the wineglass on the matches as well.—N. J. W., Caseyville, Ill.

Gravity, on the contrary, is one of the forces that make this trick possible. Its pull, plus surface friction, is what holds the three matches in position. We tried the stunt here in the office, and, impossible or not, it worked.—Ed.

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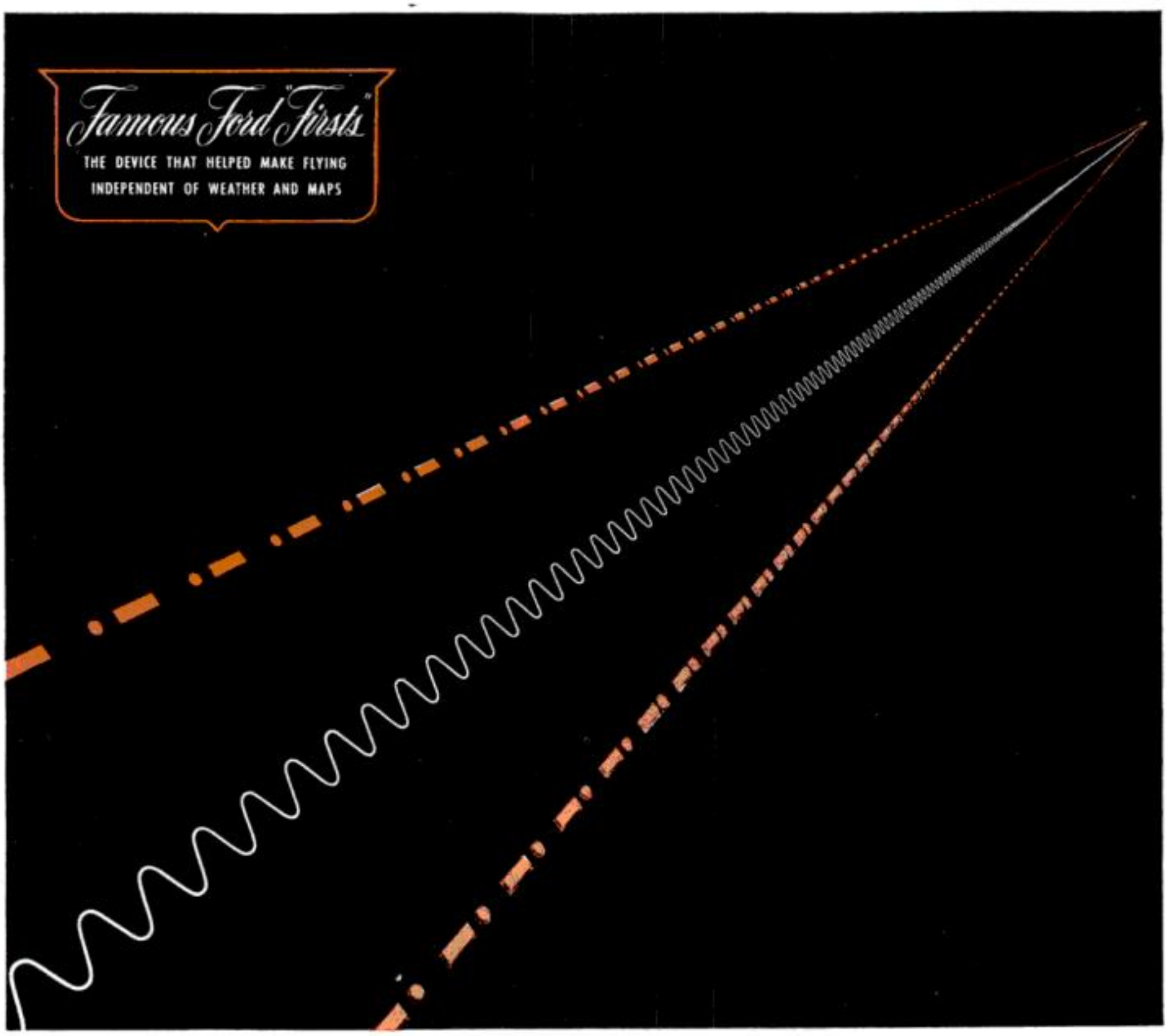
SEVERAL days ago I had occasion to pull a piece of Scotch Tape from a wall. I noticed that at the point where the tape had just been pulled away it was phosphorescent. I wondered if any other POPULAR SCIENCE reader would be able to tell me why.—S. F. C., Jr., Little Compton, R. I.

Here's the Real McCoy on the Monkey Wrench

As I was the last owner and president of the Coes Wrench Co., it may be that the following statement on the origin of the name "monkey wrench" is worthy of record. The "adjustable screw wrench" of the type allowing adjustment by the holding hand was patented by Loring Coes in 1840. I have the original model, returned by the Patent Office when they endeavored to reduce accumulations, and just before the fire that lost much model material. The word "monkey" was applied to many adjustable wrenches, but as far as we can trace, the word was first applied to a type of "adjustable spanner" made in the vicinity of Glasgow, Scotland, that required the handle to be revolved in order to move the jaws or holding faces into close adjustment. It became the habit to say, jokingly perhaps, that its "tail had to be twisted to use it," and from that and the slang use of "monkey," the final term became monkey wrench, later applied to almost any wrench that was adjustable by a screw.

Various columnists and advertising men have dreamed the title into the name of a person. No one—and the research has been extended—can find, or ever knew, of any family named Moncky, Monkey, Monk, or Monck that had any interest in wrench design, patent, or ownership. The joking application I now feel came to this shore along with the Clyborn(e) Spanner, and this because research in and around Glasgow seems to point to other similar pet names for tools. My search was made there and in London in 1890 and 1910.—Frank L. Coes, Worcester, Mass.

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Eighteen years ago the first radio range system was set up by Ford. And a Ford plane made a daring round-trip flight through a snowstorm from Dearborn to Dayton, guided solely by radio.

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THERE is many an exciting story about how amateur radio operators now in the services have helped extend the lines of victory around the world. There's the one about the "Banana Net"—the name the boys gave to the radio network down in the Panama jungle. As the G. I's have it, "it rains continually during the rainy season but only once a day in the dry season". The "Banana Net" is just one link in the vast network set up by the AACS—Army Airways Communications System. The AACS safeguards tens of thousands of lives by relaying weather reports, coordinating information on enemy ship and plane movements and by bringing home or locating flying ships that are down or in trouble.

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Readers Say:

Here Is an Idea That Is Worthy of Respect and Action

I AM greatly surprised at two letters I have seen in the last two issues of P.S.M. They stated that the authors gave their old copies of POPULAR SCIENCE MONTHLY to the scrap-paper drives. I think the magazines could do a much better job if they were given to any Army or Navy hospital, or sent to the Merchant Marine library. One of the best characteristics of POPULAR SCIENCE MONTHLY is that even the very old copies retain their interest and usefulness. As soon as I finish with a few, I give them to a "Gray Lady" friend of my mother to take to a Navy hospital where she works. She says that the patients appreciate them keenly, whether new or old. They help the morale of our wounded veterans.—O. R. S., Washington, D. C.

AN EVEN BETTER IDEA —



Crushing Power of Deep Water Depends on Circumstances

A FRIEND of mine told me of going on a fishing trip to a certain deep lake in northern Michigan. For an anchor he used an ordinary pail filled with a few large stones. He claims, with all seriousness, that the pressure of the water at the great depth to which the improvised anchor had gone had crushed in the sides of the pail. He said that he had been "strictly sober." Now I maintain that, regardless of how deep the pail had gone, the pressure would have been the same on all sides of the pail, and therefore it would have come up in exactly the same condition that it went down. Am I right?—W. W., Jackson, Mich.

Of course we don't know that particular lake, W. W., but for our money, you are right. No matter how deep an open pail is sunk, there will be no excess of outside over inside water pressure to crush it. If, however, the pail were sealed at the surface, weighted, and sunk to a depth at which the water pressure is greatly increased, the effect would be just what your friend claims. —Ed.

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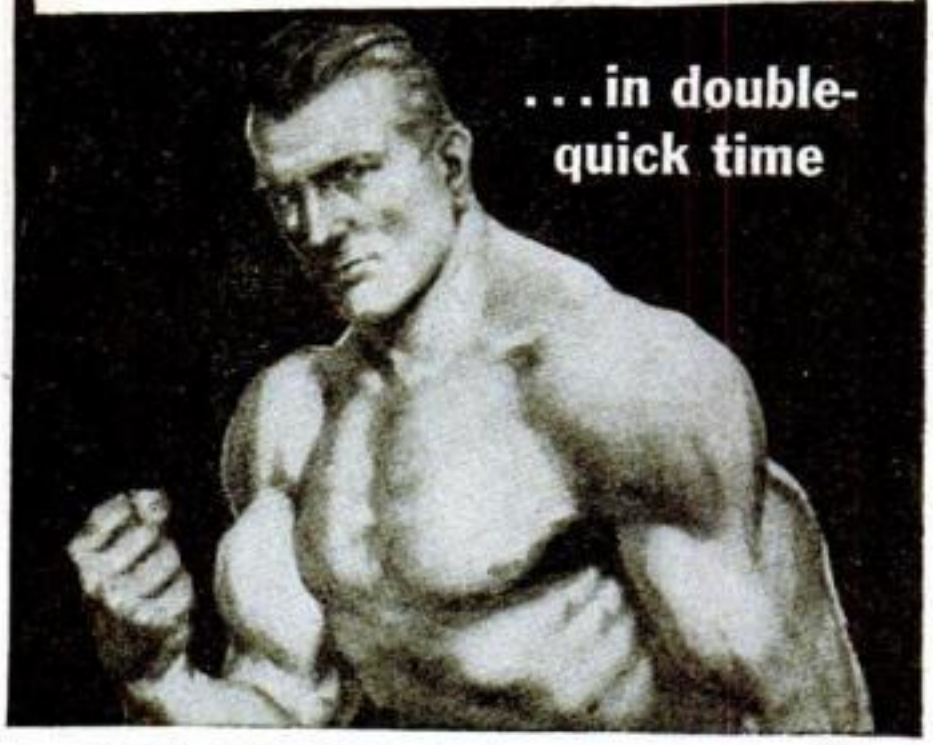
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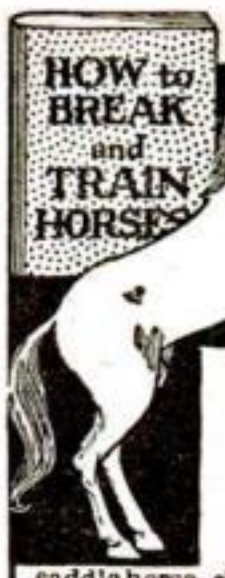
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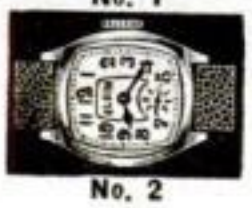


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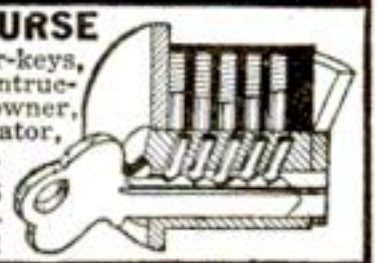
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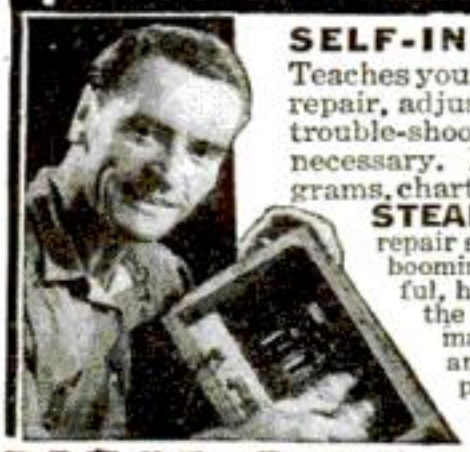
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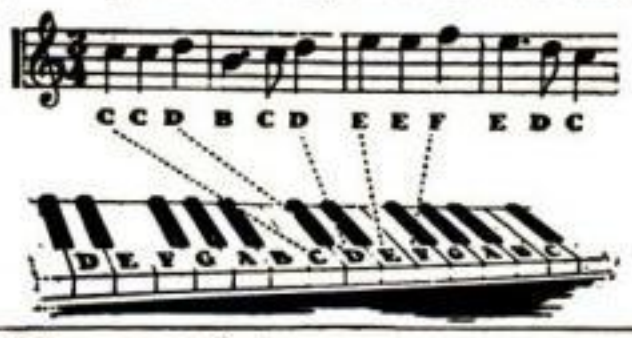
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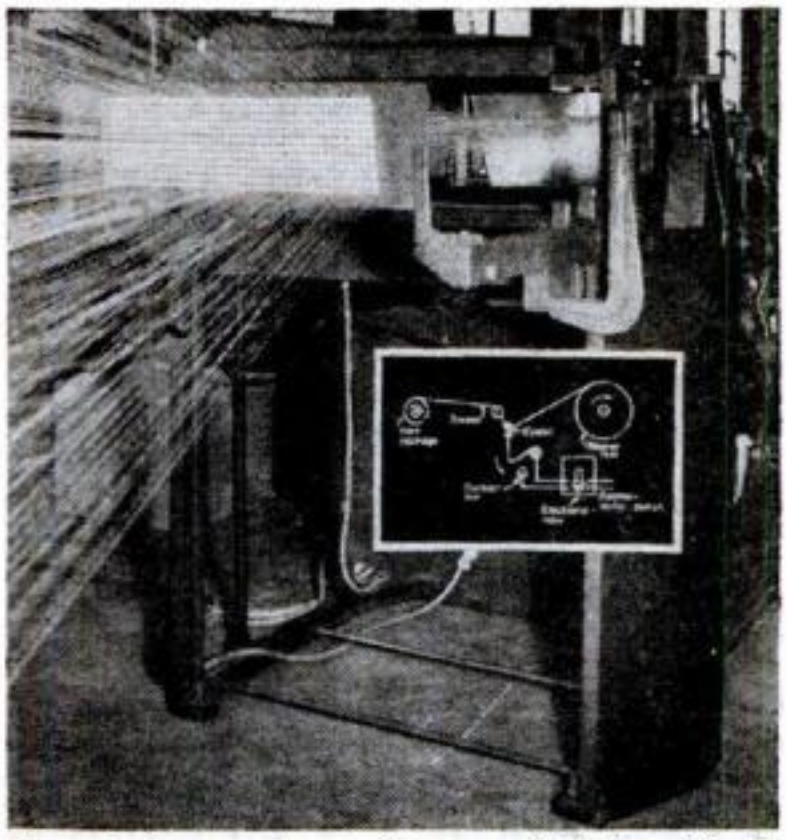
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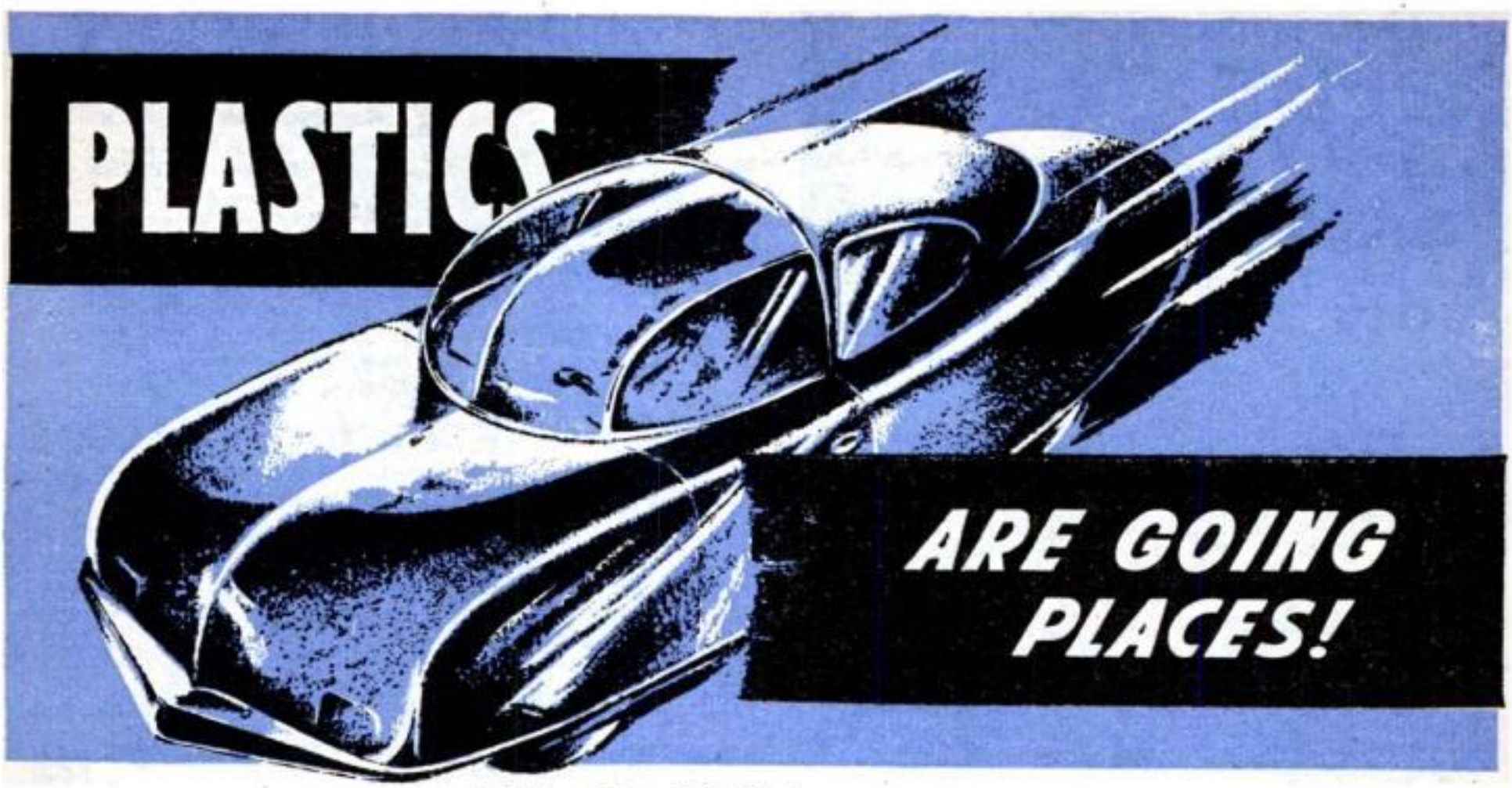
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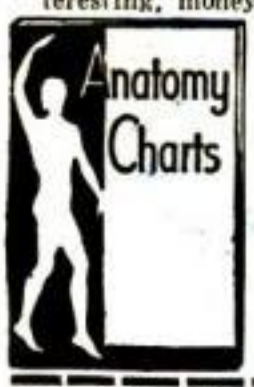
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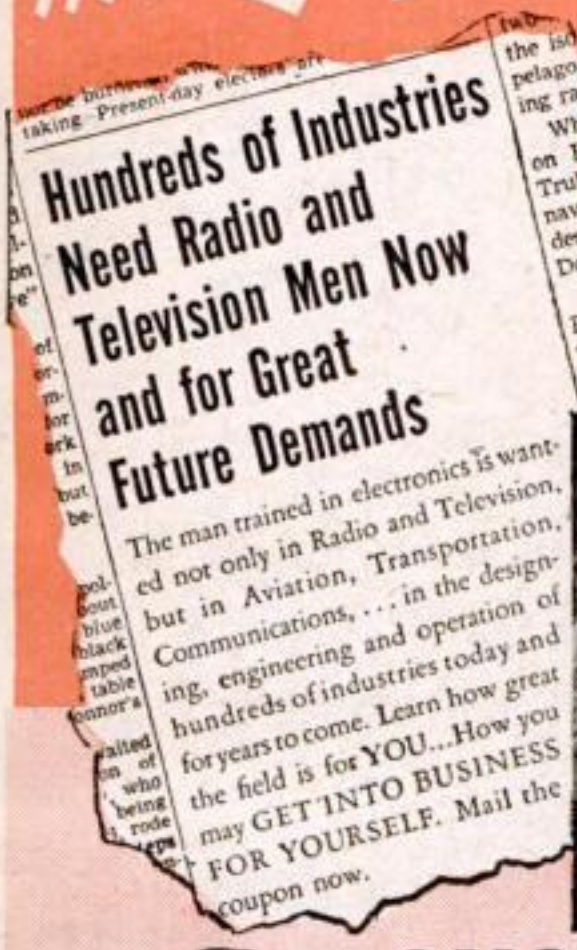
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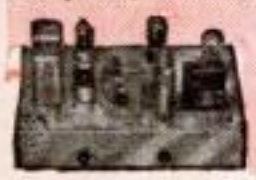


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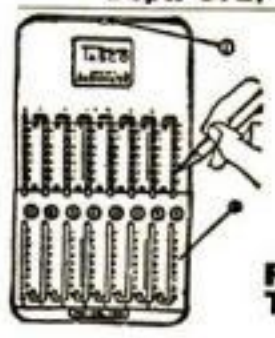
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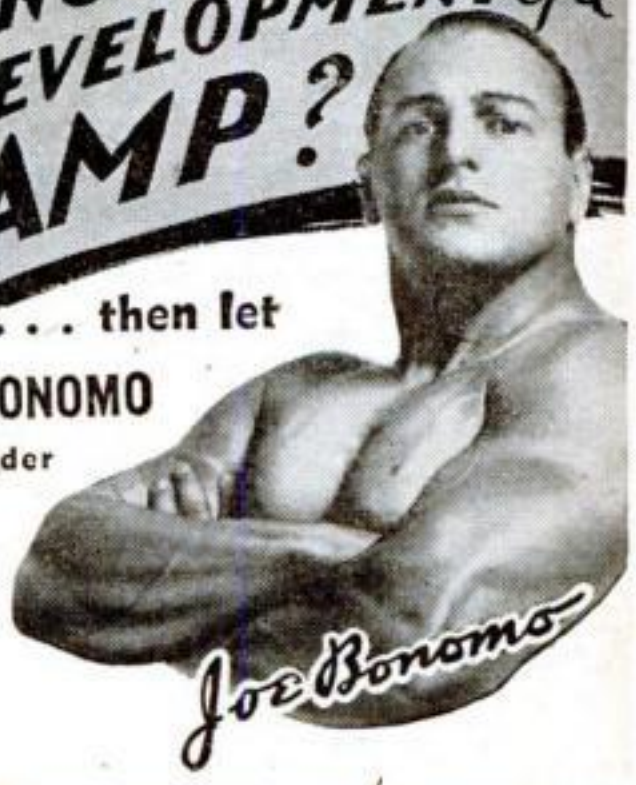
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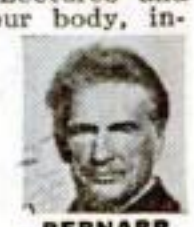
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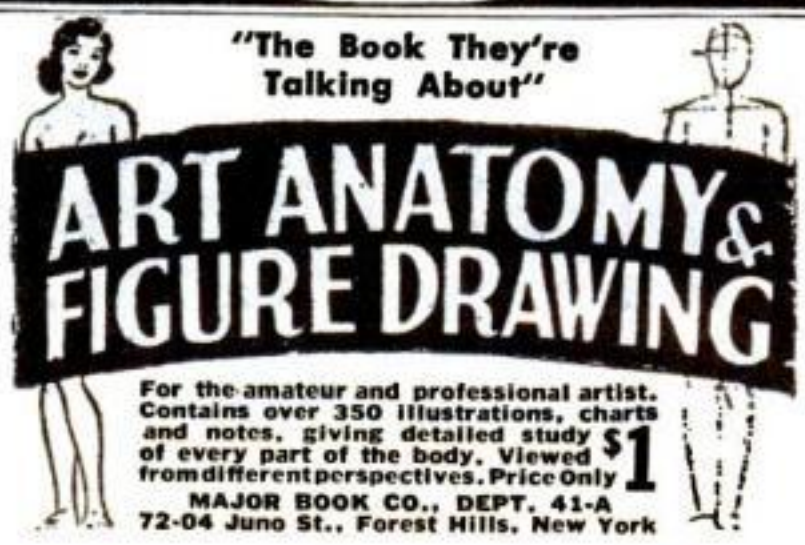


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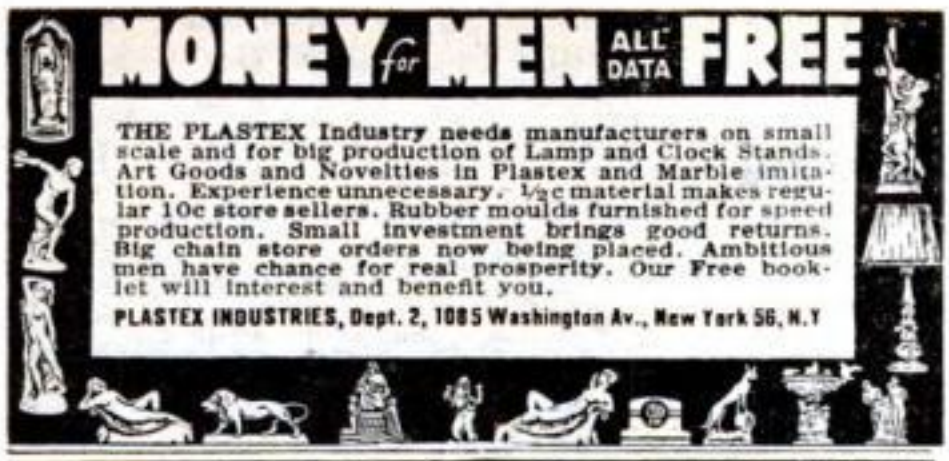
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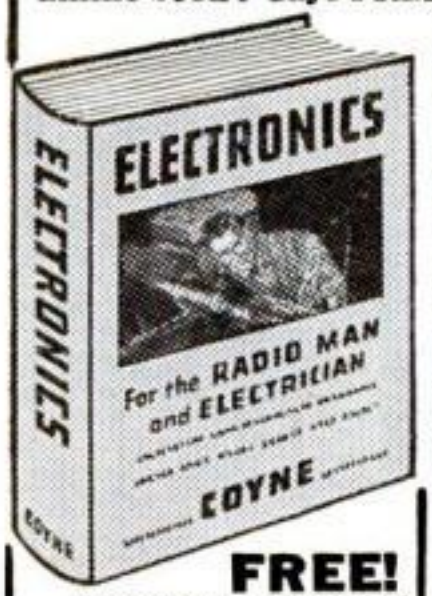
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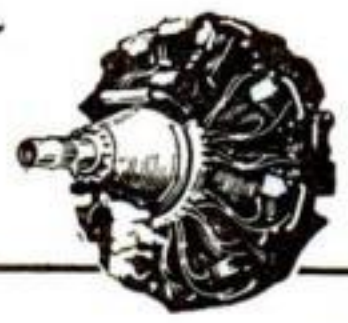


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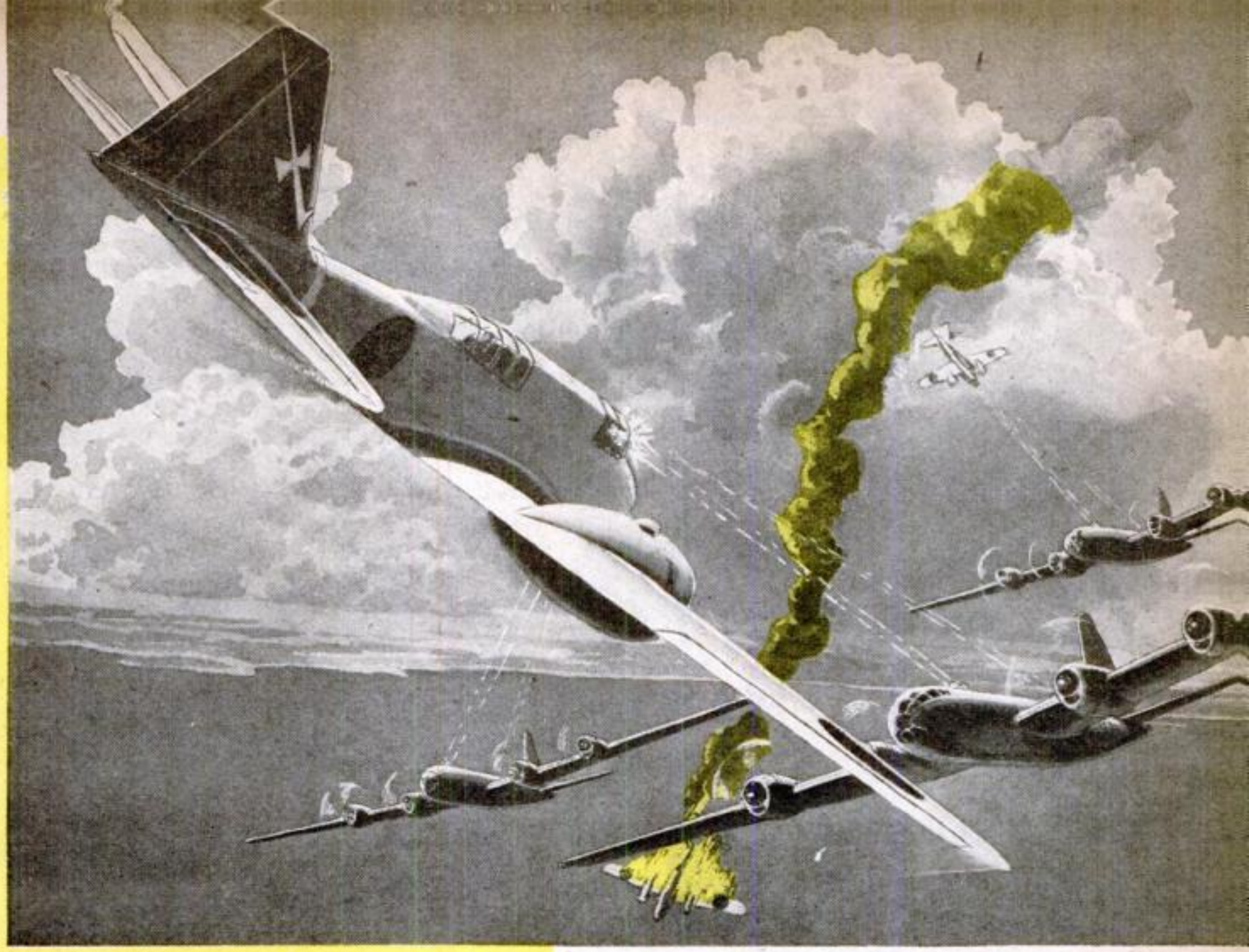
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WRIGHT POWERS THE TONNAGE OF THE AIR

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Drawing by B. G. SEIELSTAD

SUICIDE TACTICS. Japanese pilots are known to have deliberately crashed into big U. S. bombers in head-on attacks and suicide dives. Some accounts say they are using planes with nosefuls of explosives in such desperate tactics

Jap Air Force Puts New Planes in the Air

Our flyers in the Pacific are meeting better pilots and better planes as they near the Nip homeland. Is the enemy preparing secret weapons for a last battle?

By DEVON FRANCIS

OUT of three years of air warfare ranging over much of the 63,000,000 square miles of the Pacific, a new pattern of Japanese defensive tactics is developing. They bode harder going for the United Nations as they approach the core of Jap resistance.

For six months after Pearl Harbor, the Jap airman had things his own way. Then he began slipping. By mid-1944 his losing battle on the entire perimeter of his defense line was assuming the proportions of a rout. Obviously his air establishment had to be refurbished if he was to make a stand.

Today, entering the fourth year of America's participation in the Asiatic war, we are encountering bigger, faster, more heavily armed Japanese aircraft. We are encountering ingenious devices designed to throw airborne broadsides at our heavy bombing squadrons. Air-to-air bombing, as it is called, is the newest of the war's anti-aircraft techniques.

The Jap has only now begun to exhibit the length and breadth of his resourcefulness as a last-ditch fighter.

His attempts at air-to-air bombing were

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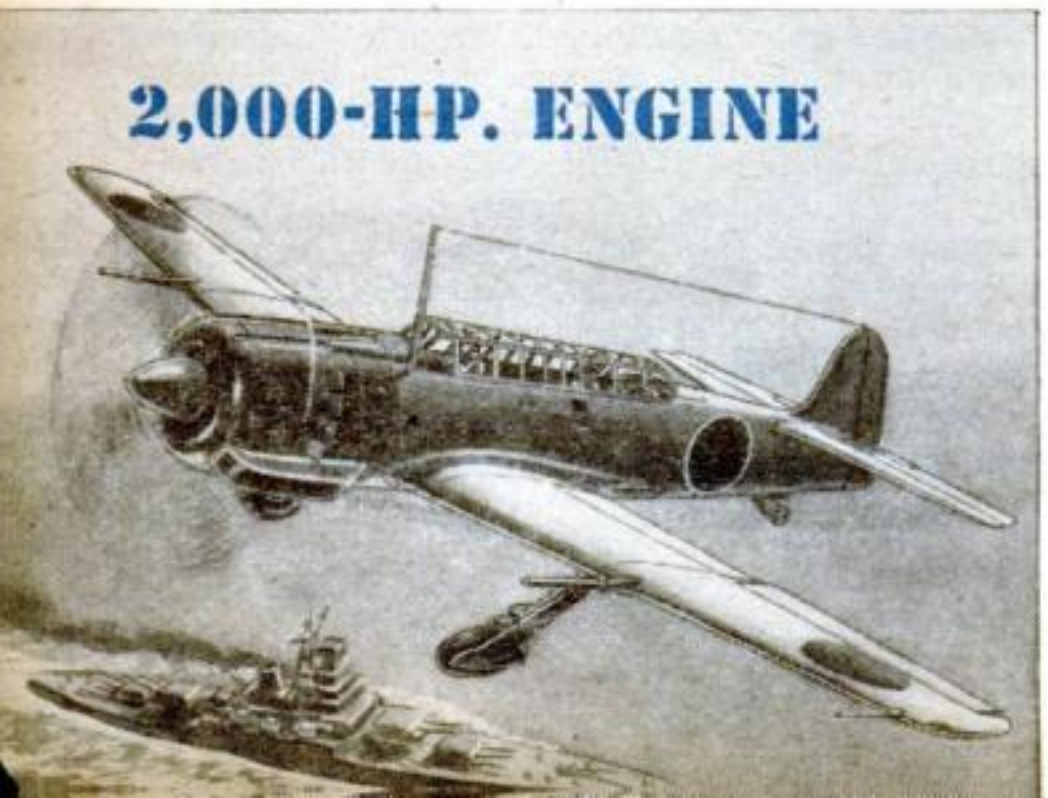


"JILL" is the name our boys have given this improvement on the obsolescent "Kate." Carries torpedo or bombs 2,000 miles; top speed is above 300



"LIZ," Japs' heavyweight, proved a disappointment operationally and is being used as a transport. The Nips have nothing like our B-29 and B-32

"MYRT" II, the best Jap carrier-based reconnaissance job, has top speed of about 375, range of 2,600 miles. Uses a double-row, 2,000-hp. engine



inevitable. His losses in direct fighter assaults on our heavily gunned bomber squadrons were becoming prohibitive. Interestingly enough, the Japanese at long last have begun to conserve their pilot reserve for the bitter battles to come in China and over the Japanese homeland.

Unlike the Germans, who experimented with putting fighter planes in line abreast and lobbing salvos of rockets at our bomber formations, the Japs are employing phosphorus projectiles in efforts to burn off the clouds of demolition-laden enemy planes striking at their industries. These are supplemented with airborne fragmentation bombs, in clusters, that burst to throw fragments in all directions at unbelievably high velocity.

On one mission, a U. S. heavy bombardment group was intercepted by Jap fighters at about 20,000 feet shortly after the planes had made their bomb run on the target. A half dozen passes were made from nose and quartering positions. The attacker came in high, leveled off for his run at 300 feet higher than the bomber, and let go at a range of 3,300 feet with one or more of ten 66-pound bombs carried under the wing.

The bomb had a three-second time delay. If the Jap's aim was correct the bomb detonated at about 800 feet ahead of and

HOW JAP PILOTS LEARN TO SPOT OUR PLANES

Intelligence school supplies flyers with silhouettes like this of the Flying Fortress. The diamond indicates wing shape; triangle, horizontal stabilizer. No side or front elevations

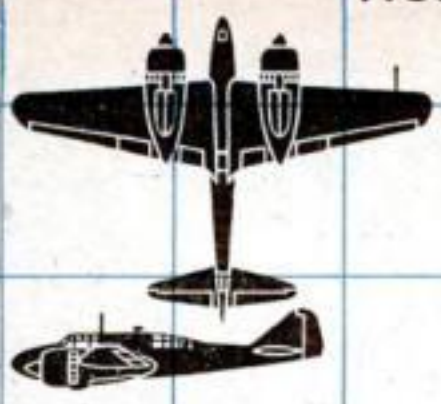


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AN ALBUM OF THE JAPANESE AIR FORCE

ARMY

FIGHTERS



DINAH. Two-seater, with a 20-mm. cannon and four 7.7-mm. machine guns. Equipped with a grenade thrower.



TONY. First Jap fighter with in-line, liquid-cooled engine. Speed is about 360 m.p.h.



OSCAR II. Climbs 3,300 feet a minute. Replacing Oscar I in India Theater.



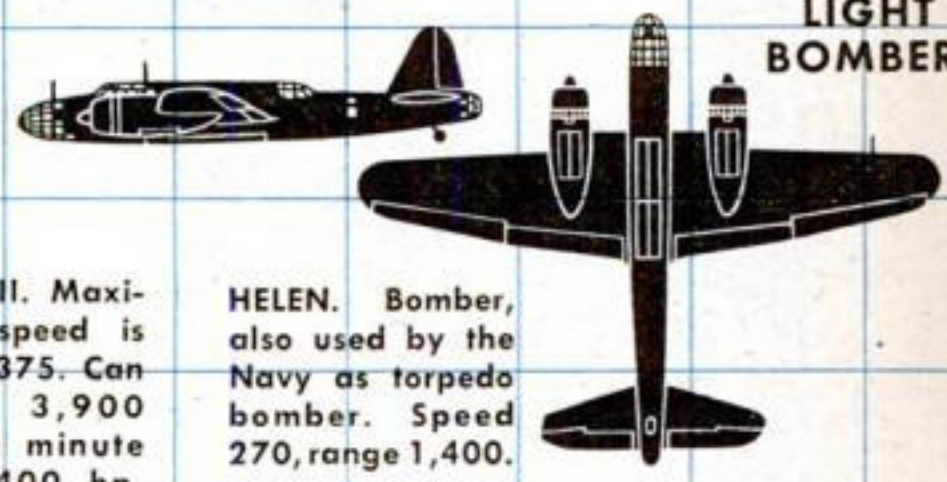
TOJO II. Maximum speed is about 375. Can climb 3,900 feet a minute on 1,400 hp.

TWENTY-FOOT SQUARES



SALLY. This and Betty are Japs' best bombers. Top speed is 224 m.p.h.; range, 2,480 miles.

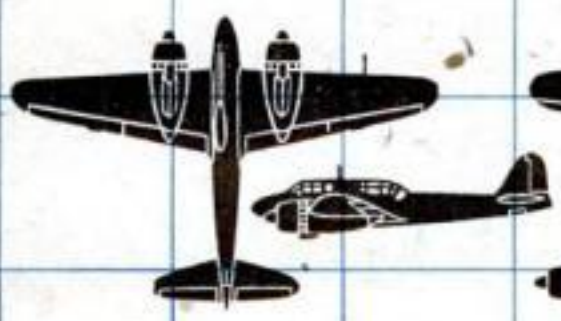
LIGHT BOMBERS



HELEN. Bomber, also used by the Navy as torpedo bomber. Speed 270, range 1,400.

NAVY

FIGHTERS



NICK. Two-seater night fighter. Range 1,300. Three machine guns, one 37-mm. cannon.



ZEKE. Improved Zero. 350 m.p.h. Range 1,500. 1,100 hp.

DIVE BOMBERS

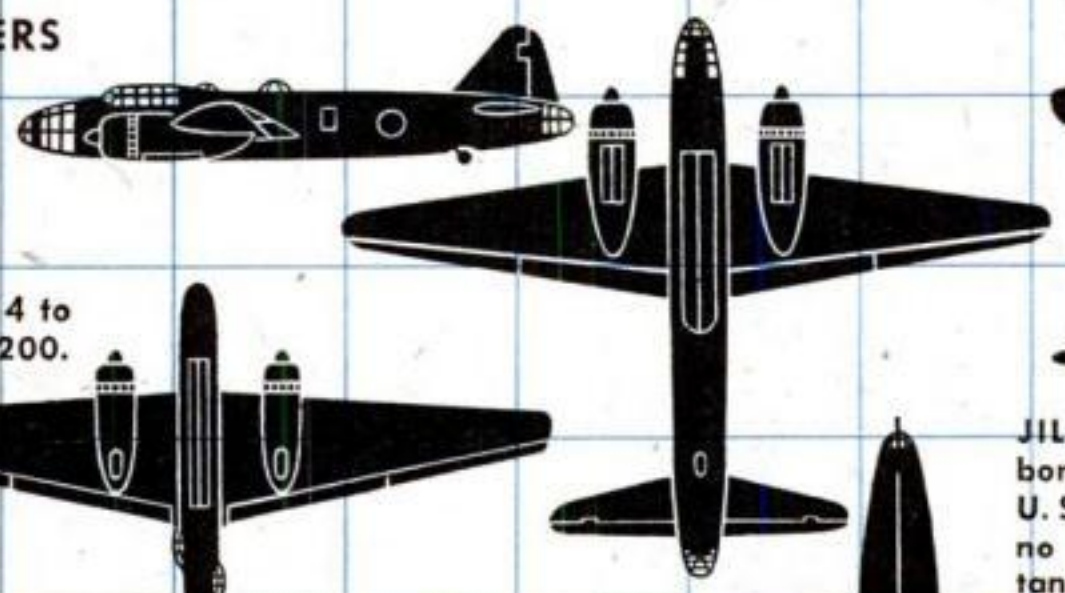


JUDY. Dive bomber. 330 m.p.h. Range 2,100. Bomb load 750 pounds.

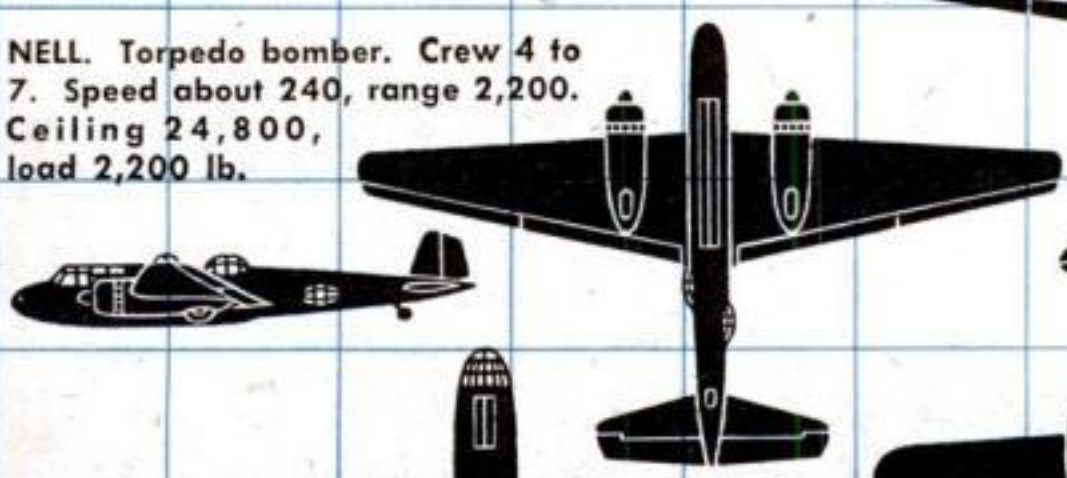


JAKE. Mostly reconnaissance. Four 132-pounders. Top speed 216 m.p.h.

MEDIUM BOMBERS



BETTY. In class of our B-25, B-26. Carries 1,584 pounds of bombs 2,110 miles at 205 m.p.h.

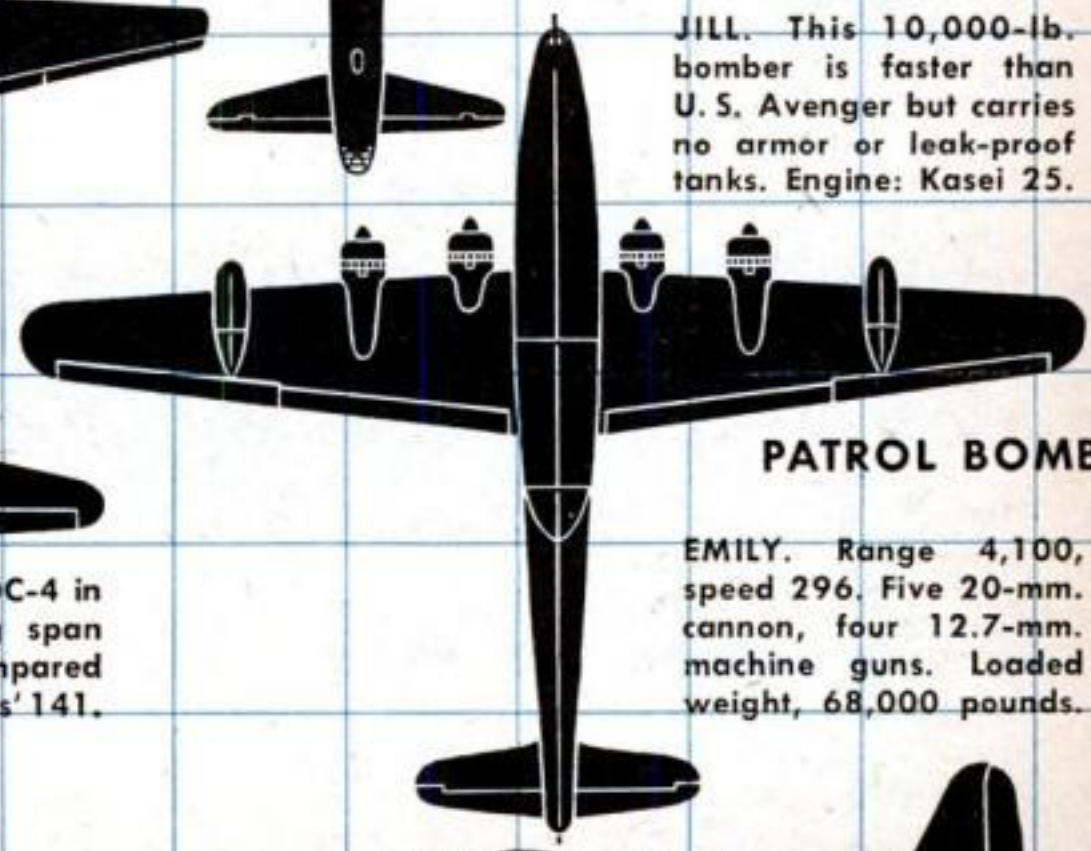


NELL. Torpedo bomber. Crew 4 to 7. Speed about 240, range 2,200. Ceiling 24,800, load 2,200 lb.

TORPEDO PLANE



JILL. This 10,000-lb. bomber is faster than U. S. Avenger but carries no armor or leak-proof tanks. Engine: Kasei 25.



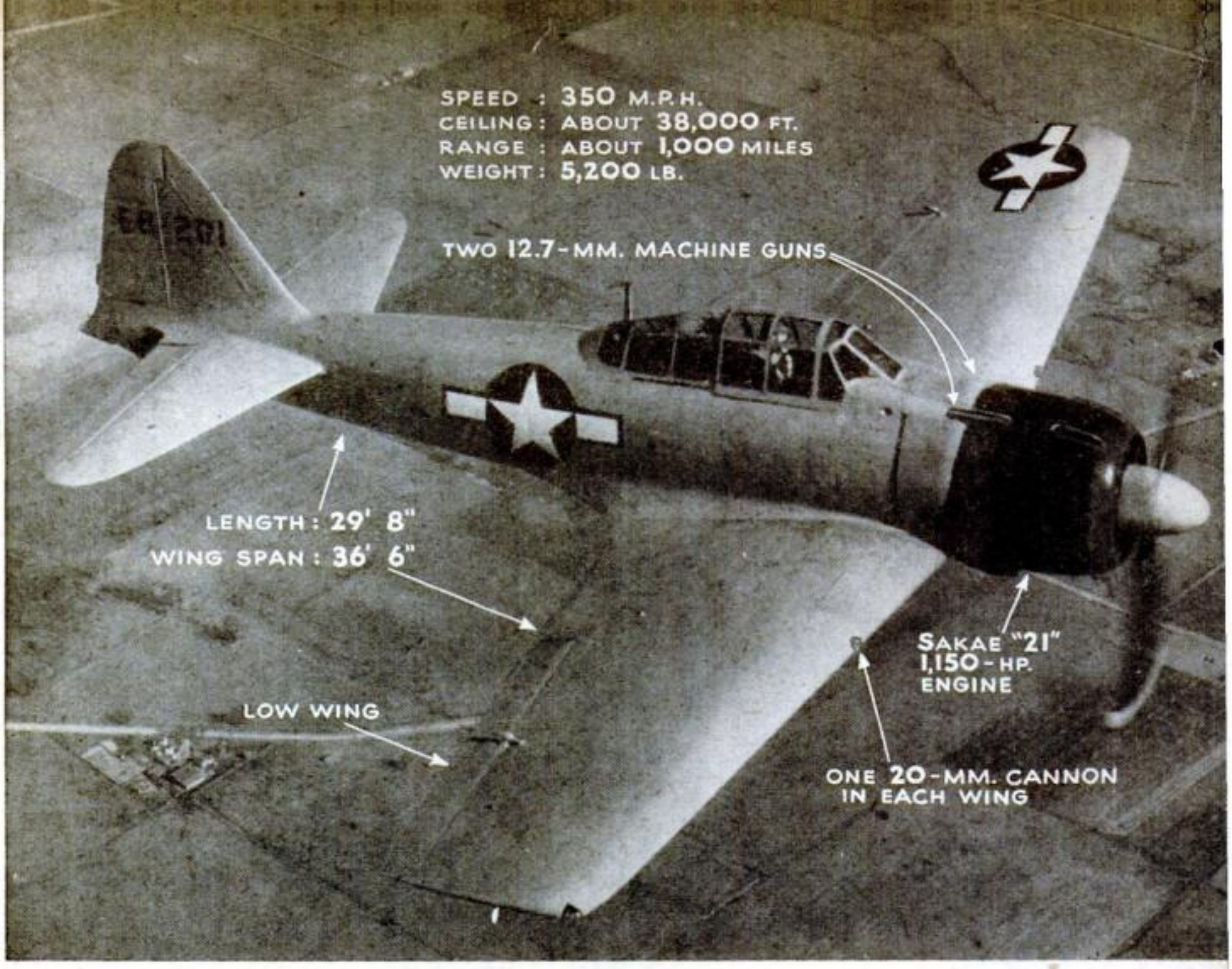
PATROL BOMBER

EMILY. Range 4,100, speed 296. Five 20-mm. cannon, four 12.7-mm. machine guns. Loaded weight, 68,000 pounds.

HEAVY BOMBER

LIZ. Resembles DC-4 in silhouette. Wing span 140 feet, as compared with Superfortress' 141.

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HAMP VS. HELLCAT. Differences between Jap and U. S. planes are more real than apparent. Here is a captured Zeke 32 (Hamp), a refined Zero, wearing U. S. insignia for test-flying. Compare it with the Grumman Hellcat on the opposite page. Muzzle velocities of Jap guns are below those of our weapons

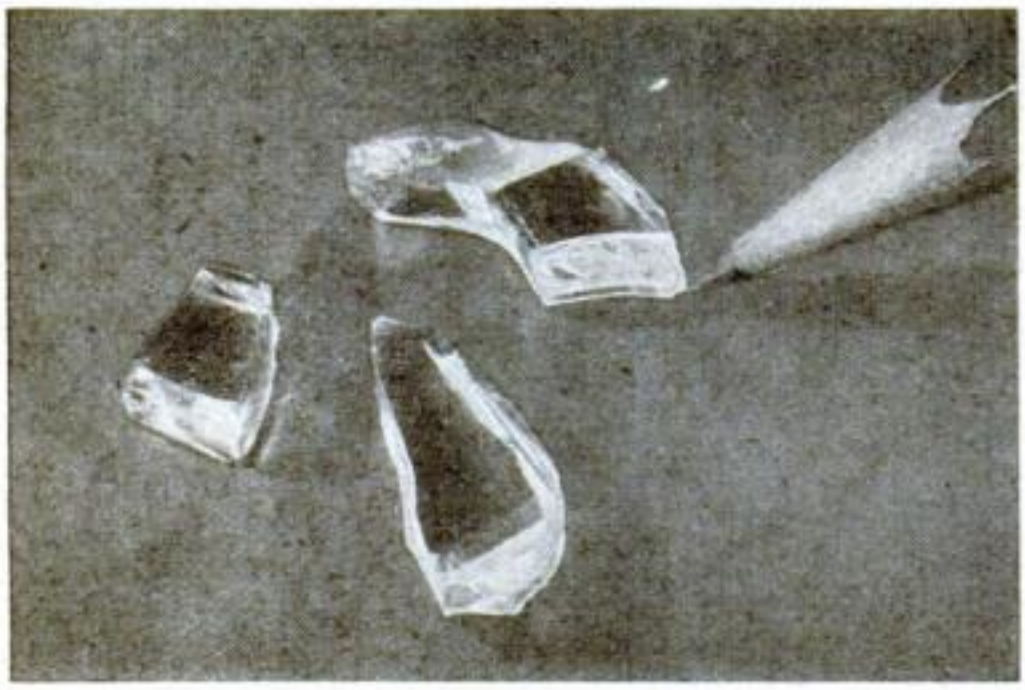
200 feet above his target, since the rate of closure between bomb and target was 800 feet a second.

The attack was a fair sample of the new Japanese tactics.

The Japs also are using a new 132-pound air-to-air bomb and experimenting with rocket projectiles. Stories are current that they employ curtains of canisters hung from wire ribbons attached to parachutes. The ribbons are of different lengths to saturate both vertically and horizontally the portion of the sky that is occupied by an enemy bomber fleet.

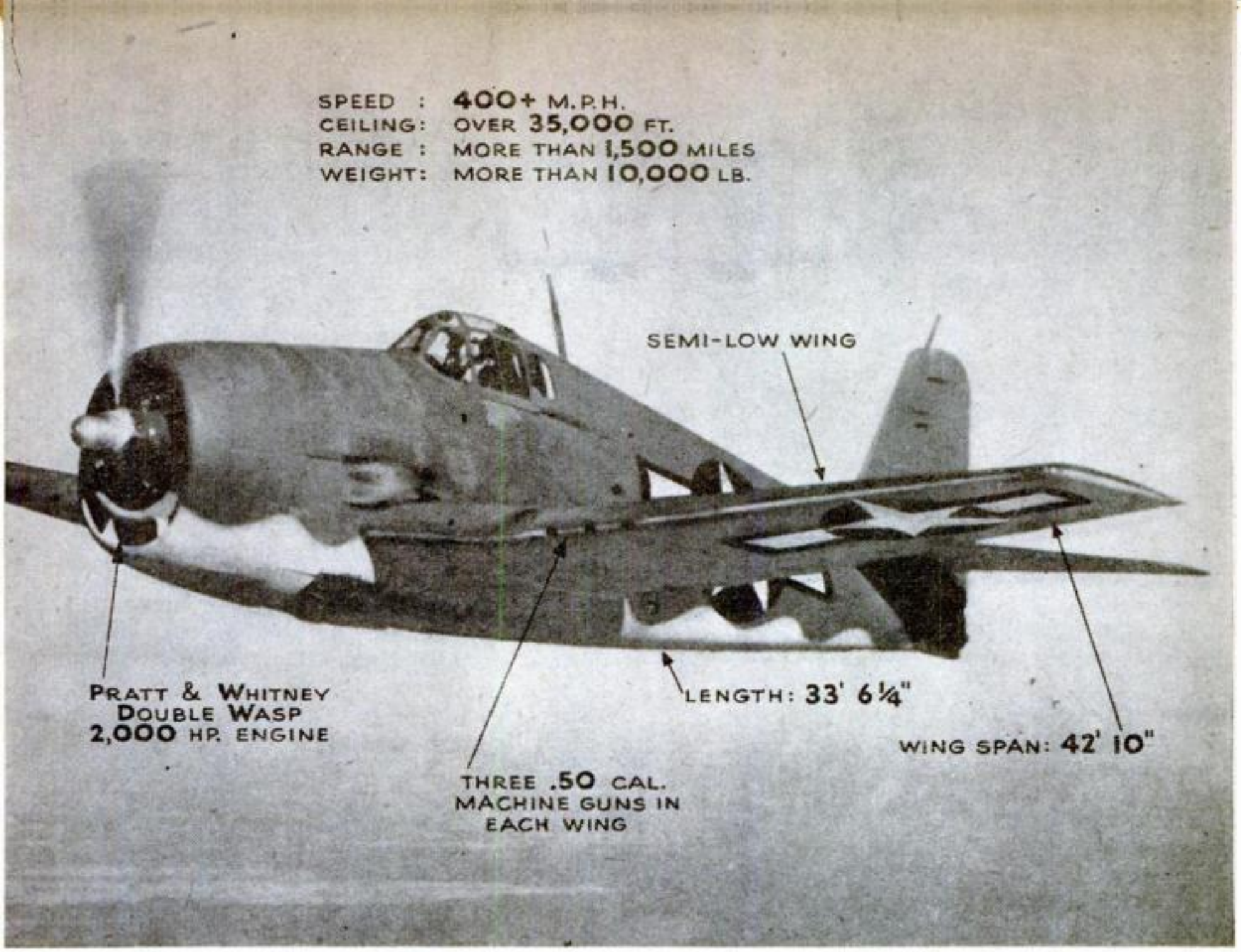
There is little question that the Japanese are hoarding new types of extremely fast, heavily armed planes for the battles to come. Some of them have been glimpsed briefly on the outer edge of their air-defense-in-depth. At least two, perhaps three, of their fighters are in the 400-mile-an-hour class. For the first time they have introduced a four-engine land-based bomber, ostensibly for assaults on newly won United Nations bases.

One of their new fighters has an in-line, liquid-cooled engine, a good approach to such U. S. types as the Mustang, the world's fastest. A long-range Jap reconnaissance plane has a 2,000-horsepower engine in its nose. That is only 200 horsepower less than the highest the United



JAP WINDSHIELD. To save their air crews for the desperate battles to come, the Nips have tried to make bulletproof windscreens. These pieces are from a crashed Helen

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Both the Hamp and the Hellcat carry armor plate and self-sealing fuel tanks. However, Jap armor can be shattered with .30 caliber fire, while U. S. armor turns .50 caliber bullets. Jap self-sealing tanks are inferior. The Hellcat was designed to meet U. S. flyers' demand for faster climb and higher ceiling

States now uses operationally in a plane.

It is a foregone conclusion that we shall meet Jap jet-propelled aircraft, inspired by the German technicians who since Pearl Harbor have stood behind the Japanese designer and helped guide his pencil.

Japanese aircraft have gone through a complete reversal in design trend in the last few months. In the beginning they were small, light, lightly armed and without armor plate. They were beautifully fashioned. They were finished, in fact, much better than American aircraft. They could outclimb and outspeed our planes. They had higher ceilings.

"There I was," recalled a Wildcat fighter pilot of the Solomons campaign, "hanging at 30,000 feet at 90 knots (a bit more than 100 miles an hour) in a ship that was likely to fall off into a spin at any moment, while Jap Zeros were doing loops all around me."

It was simple. The famous Zero, now redesigned as the Zeke, models 32 and 52, weighed but 5,500 pounds as against 12,000 to 15,000 for its adversaries. The aluminum-alloy skin of those early fighters was so thin that it could be bent between the fingers.

But Jap design had its weaknesses, and American fighter pilots took advantage of them. The moment an American got on a Jap's tail with a good burst, that thin skin peeled off like the rind of an orange, or the fuel tanks, unprotected by self-sealing compositions, exploded. Because their planes were so lightly constructed, most Jap pilots did not attempt to outdive their foes. They knew that at high speeds the outsize ailerons, built into their aircraft to give high maneuverability, would "freeze"

Jap armament was inadequate. Fighter pilots and the crewmen of bombers were given the equivalent of our .303 caliber deer rifle in machine guns, plus 20-millimeter cannon. Both were of low velocity. Jap gunners found their targets with .303's liberally laced with tracers and then opened up with the cannon.

U. S. planes had nothing less than .50 calibers. One of our fighters mounted a 37-mm. cannon and the rifles on our medium bombers ran up to 75 mm.

Most of those early Jap planes have disappeared. Here is a gallery of new Jap air developments:

The army fighter Tojo, like all the other

Copyrighted material

late-day Jap fighters, is armed with four guns of a caliber approximating our .50's. It carries armor plate to protect its pilot. It is less maneuverable, but a good deal sturdier, than its forebears. Resembling our P-47 Republic Thunderbolt, it has a top speed of 380 miles an hour.

Judy, replacement for the aging dive bomber Val that wrought part of the destruction at Pearl Harbor, has a top speed well in excess of that of our standard Navy dive bomber.

The Dinah Mark II, twin-engine fighter, performs spectacularly. It can carry its crew of two to 10,000 feet in a fraction more than three minutes.

Betty, navy twin-engine bomber workhorse, incorporates a new power-operated gun turret. For months, by the way, the Japs were ahead of us with bomber nose and tail turrets that could be rotated 360 degrees to permit gunners to cover any angle of attack, front or rear.

The Jap Mitsubishi Kinsei radial aircraft engine has been boosted in horsepower from a meager 900 to 2,000. As beautifully machined as anything turned out in the United States, it has machine-cut cooling fins on its cylinder barrels, a process that succeeded sand-casting only a short time ago in this country.



JAPANESE PILOT is one of the mysteries of the Pacific war. Tricky one moment, he may go to pieces the next in a tight spot. Cocky at the beginning of the war, he is now becoming wary in the face of superior opposition. In comparison with U. S. pilots, he has mediocre training, knows nothing of air teamwork

In engines we have an edge on the Japs. They are able to draw only a half horsepower out of each cubic inch of cylinder as against three quarters of a horsepower obtained by American manufacturers.

Jap adaptations of foreign equipment are endless. The U.S.-manufactured Fairchild aerial camera has been copied, even to the model number and the U. S. Navy's inspection insignia. But in fitting it to their own uses the Japs improved it by borrowing a multislot focal-plane shutter curtain from the French Gaumont camera, giving it a wider speed range. They installed a German cut-film magazine, superior to American magazines.

The Japs have new radio detection devices, something comparable to our radar.

Jap tricks, Jap deceits, are almost innumerable.

Lately, when a Japanese reconnaissance plane is attacked and the pilot has to bail out, he will toss overboard a parachute-borne automatic radio sending set to give his home base a "fix" on the location of the attack.

Japs use U. S. Army Air Forces signals and tactics to confuse their adversaries. In night assaults they will switch their lights on and off in one quarter to distract attention from a foray from another quarter. They use air decoys. On the ground their camouflage is nearly perfect. They dispense with tracers in their antiaircraft fire to hide their gun positions. They set traps, such as oil drums left in the open to invite strafing.

Up against major-league opposition for the first time in his modern military history, the Jap has learned quickly. He copied the U. S. Navy "Thach weave," a to-and-fro flying maneuver by two-plane elements that protects each pilot from a surprise attack.

But the Jap is notorious for mediocrity in pilot material and in tactics, and on those shortcomings we are capitalizing. The Jap cannot think when he gets in a tight situation, for all his undeniable skill as a pilot.

"I got boxed by a brace of floatplanes," related the pilot of an Avenger torpedo bomber, "but I made a cloud. I stooged around for a while, and when I came out the Japs were gone. U. S. Navy pilots wouldn't do that. They would have hung around that cloud the rest of the day."

The Jap's evasive action consists of fitful turns or diving. The one makes him lose air speed and frames him for a perfect target. The other renders him a sitting duck for the one-two attacks by teams of American airmen who have learned that collaboration enables them to live to fight another day.

Jap pilots have a predilection for sense-

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AIR-TO-AIR BOMBING is the latest trick to be tried by the Japs in an effort to stop our bombing raids without sacrificing their pilots. Here a phosphorus bomb dropped by a Zero bursts off the wing of a Liberator in a Seventh Air Force formation striking at Truk. Phosphorus bombs, designed to set attacking planes afire, are supplemented by fragmentation bombs that throw splinters at high velocity

less acrobatics. They cannot make a deflection shot—one in which they must compensate for the difference in the angular courses of their own planes and their targets, relative speeds, range and the velocity and trajectory of their bullets. They waste an appalling amount of steel trying for high stern runs, and a direct burst, on enemy planes. Inexplicable things happen. A Jap fighter will stand off out of range and empty its guns and then wheel about and scoot for home. It bewilders the opposition but it doesn't help win the war for Hirohito.

Japs live by the samurai code, which does not allow them to be captured. Only death is honorable. Some of the results are weird. One Jap pilot, told that he must never leave his plane's operations manual off his person, bailed out with it and courteously presented it to his captors. Because he theoretically could not be captured, he could not be told what to do if he was.

There is little question that we have killed off or captured the best of the Jap airmen—apart from those assigned to the defense of China and the homeland. Jap air squadrons used to contain four enlisted pilots to one officer. Now the ratio is six to one. Only the officers are briefed before a mission. When a majority of the officers are shot down, the flight begins to disintegrate.

The Jap mind, architect of a quick war and a hard peace, has begun to exhibit contradictions in impulse and duty. Often the Jap airman is anxious to save his own skin. His interpretation of honorable conduct is becoming elastic.

But he is being urged at the same time to make suicide dives into our bomber formations. *(Continued on page 234)*

THIS IS A JAP AIR-TO-AIR BOMB

Japanese rifle grenades, modified to take tail assemblies as shown at the right, are now dropped in clusters from planes against American bombers. They are small, not much longer than the span of a hand (see cover), and carry powerful charges. As a part of their defensive tactics, the Japs drop these in large quantities on our raiding formations. Other bombs being used in air-to-air work include 66-pounders that are carried under the plane wings, and a new 132-pounder. Nips are also said to be experimenting with rocket projectiles like those used with varying success by the Luftwaffe



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The Liberator B-24 bomber isn't exactly a low-level worker, but the U. S. Navy's patrol-bomber squadrons get results that way.



Death for Japs Flies at Fifty Feet

By TED STEELE
Lieutenant, USNR

AT THE end of its sector, a lone Navy search plane turned away from home. For six hours the pilot had flown his Liberator over a huge, empty, and beautifully monotonous pie-slice of ocean trying to find any Japanese movement by submarine, surface craft, or plane. With Eniwetok, then the most forward American base in the central Pacific, as the apex, the pilot was near Truk at the end of the pie slice. Instead of searching the short leg and returning to base, he flew on toward the great Japanese bastion.

A hundred miles out, the pilot shoved the big Liberator down to 50 feet altitude. At 50 miles out, he took it on down to 20 feet. (The tail gunner said flying fish were going over his head.) In the moonlit darkness the reef surrounding Truk's lagoon flashed briefly and the plane was inside the lagoon. Bow gunner, top-turret gunner, belly gun-







AT SEA . . . It was just too bad for this 500-ton Jap freighter when it was sighted somewhere southwest of Jaluit by a Liberator of the Navy's Bombing Squadron 109. Lt. Comdr. William Janeshek and his crew gave the cargo carrier a thorough going over with bombs and .50 caliber machine guns, with the final result shown below. As a rule, Jap ships have better AA protection than land targets. In addition to their routine patrols, in which they sweep vast sectors of ocean, the big planes of the VB squadrons are allowed to strike out on their own to pick up tempting targets like this



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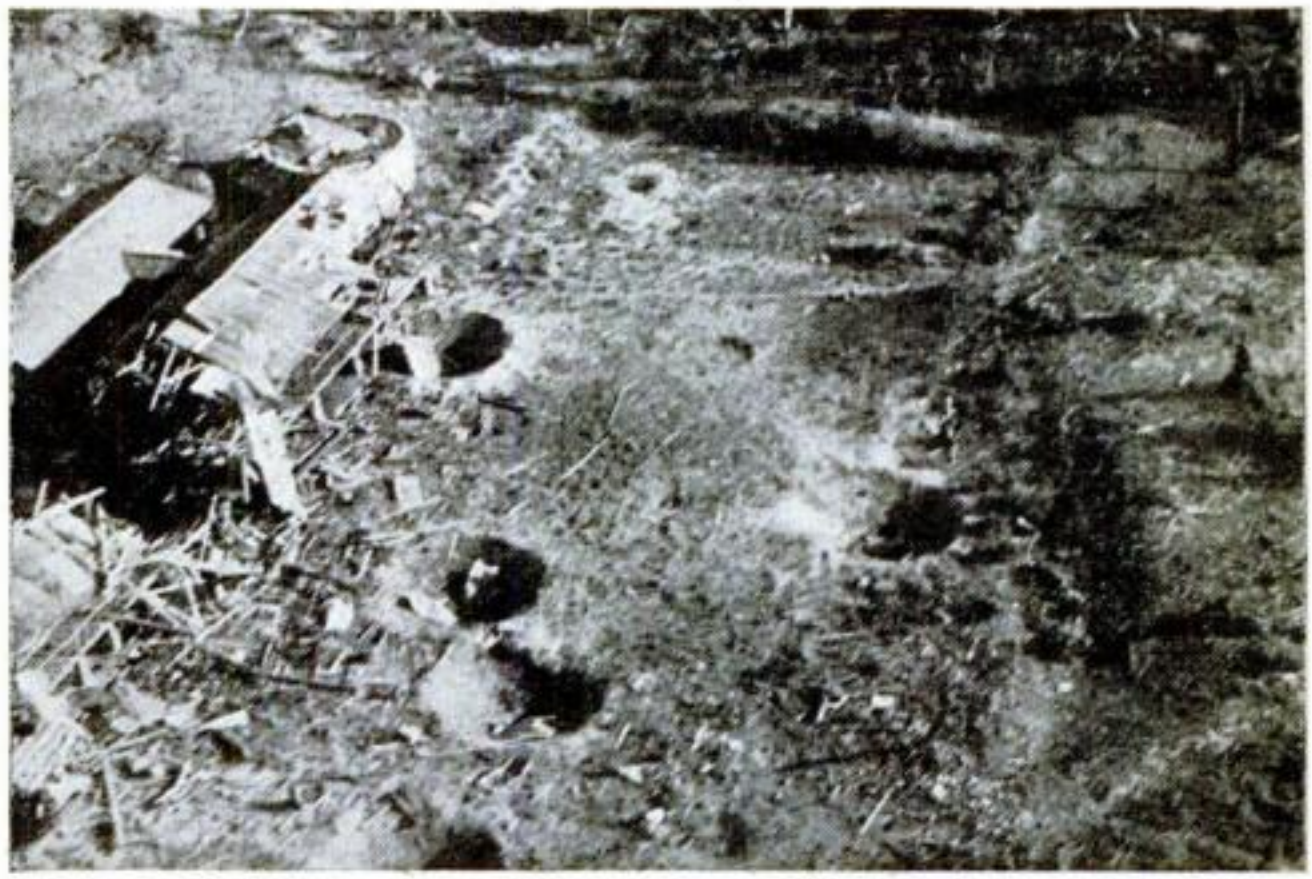
ner, tail gunner, and the two waist gunners were at battle stations. The radioman on the catwalk in the bomb bay was ready to hold the bomb-bay doors open in case anything failed to function. Ahead and to the south the hump of Moen, the largest of Truk's islands, loomed up, while directly ahead little Fanuela Island rushed at them, swept below. A mile past Fanuela, a Japanese destroyer lay at anchor.

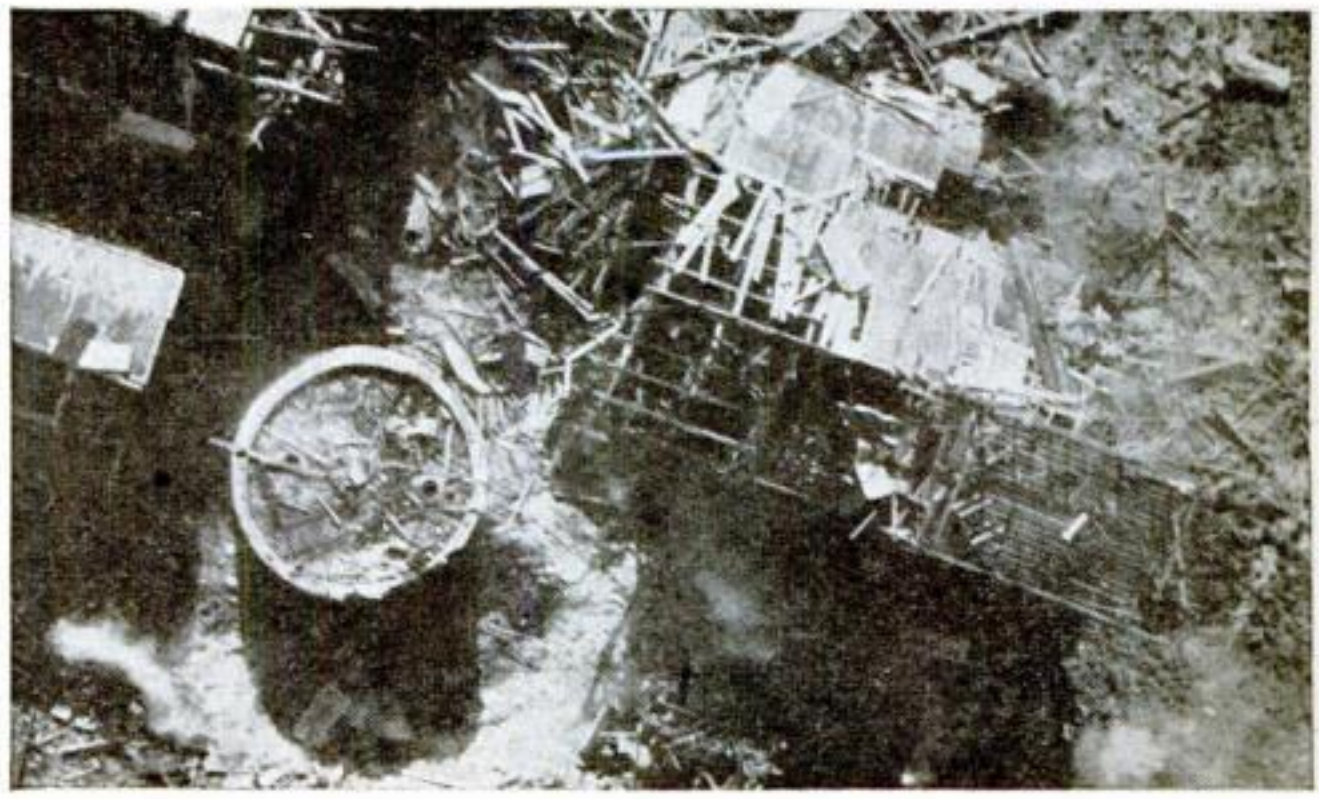
There were no signs of the Japs having been alerted. The pilot, Comdr. Norman M. Miller, USN, came up to 200 feet altitude and increased his manifold pressure until he was making 200 miles per hour, indicated. But the Japs began to wake. Searchlights probed the sky, and the Liberator's crew could see the yellow-and-white flashes of the AA on the shores of the islands.

Commander Miller settled into a bombing run as the destroyer blazed with antiaircraft fire. The glare of the guns and the glare of the bursts blinded him a little, ruining his night vision, and he lowered his head, watching his altimeter (200 feet) and his airspeed meter (200 miles per hour). At the last second he looked out again at the destroyer, now clearly silhouetted by its own gunfire. Holding the bomb-release button—the "pickle"—in his right hand, he waited to squeeze



ON LAND . . . Quite by accident, Comdr. Norman M. Miller, commanding officer of VB-109, stumbled on this Jap airfield under construction on Ponape. Running down the runway at 30 feet, he mowed down the startled workmen with his machine guns and blew up their equipment. From then on, the squadron paid regular visits to the field—sometimes twice a day—until reconnaissance photos showed the devastation pictured below





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it until his improvised bombsight told him he couldn't miss.

The radioman in the bomb bay saw two 1,000-pounders go down, a fraction of a second apart. The port quarter of the destroyer flashed under, then the long stretch of the deck, then the starboard bow. The first bomb hit with a mushroom on the quarter, the next close on the bow. The tail gunner watched the mushrooms blossom, watched the destroyer lift itself from the water and fall back. That was all he saw, for the night suddenly turned to a hard glare as two searchlights caught full on the Plexiglas dome in which he sat.

Commander Miller was fighting the jolting blows of the flak explosions. Two searchlights on Moen Island held his plane like a fly impaled on a pin. The altitude was still 200 feet, for the pilot could not make any radical maneuvers without flying the plane into the water. To pull her up would kill his speed and throw the whole belly of the plane into the lights for the guns which were hammering away from all the positions in range. He eased the big plane in a gentle turn to the left, away from the guns. The lights followed him and the yellow flashes crept to the left. Then he jammed it hard around to the right, the long wing tipping steeply toward the water. The Liberator broke out of the grip of the searchlights and into the welcome security of darkness.

The searchlights seemed confused and circled far to the right of the plane. Instead of streaking for home, Commander Miller turned and headed back toward the airfield on Eten Island. "I'm going down the runway," he said to his crew. "Let 'em have it!" They went down the runway at 50 feet. Everything that could shoot in his plane was going full blast and the plane felt like the inside of a riveting gun. From the end of the runway they turned again and flew over the seaplane base, listening to the tail gunner tallying the damage to small ships and tenders going up in flames as the .50 calibers chewed into them. Commander Miller turned again and crossed the narrow water to Moen Island, racing down its airstrip with all his guns spraying everything in sight.

The bombs were all gone and the gun barrels burned out. The navigator told him he had been inside Truk's lagoon for 18 minutes. Commander Miller had one depth charge left for use against anything he might find on the way home, and, down at 20 feet again, he gunned the plane over the white line of the barrier reef and headed back to complete the outer leg of his search sector. The Japanese Navy was minus one destroyer — and that at the very time when it couldn't afford to lose a rowboat.

Comdr. Norman M. (Bus) Miller, USN, was commanding officer and pacesetter of Bombing Squadron 109—a squadron famous throughout the Pacific for its succession of daring low-level attacks and its unheard-of record of destruction of enemy shipping and shore installations. This attack could have been made by any one of his 20 patrol-plane commanders at any Japanese base in the central Pacific, for, in 7½ months, the great planes of VB-109, flying singly and alone, cut a path ahead of our forces through the Gilberts and Marshalls, the Carolines, the Marianas, to the Bonins, Kazans, and Volcanos within 500 miles of Japan itself.

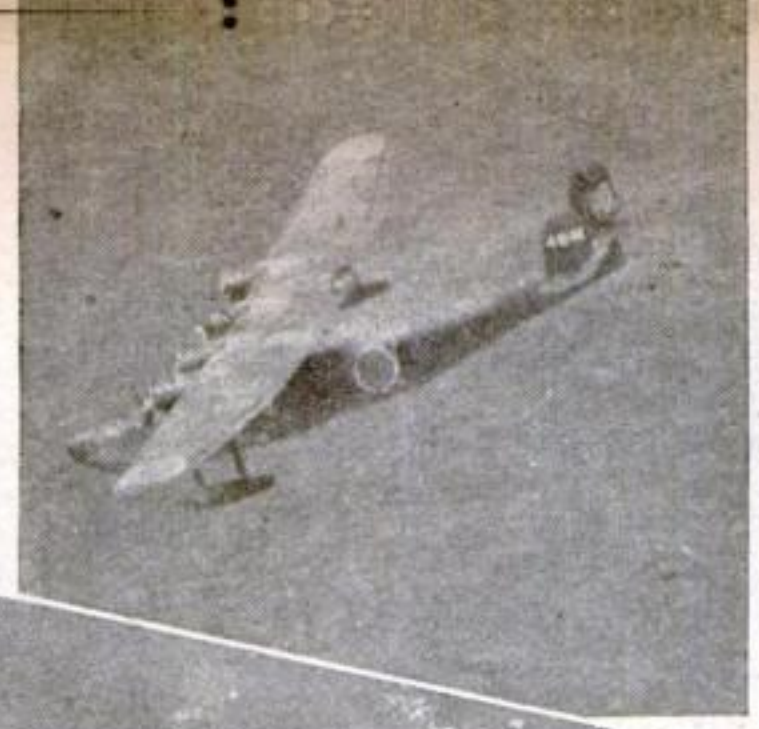
VB-109 was a Liberator squadron. The Liberator, of course, was designed as a high-altitude bomber for the Army, and for best operation at altitudes above 20,000 feet. At 200 feet it is clumsy, slow, and fairly unmaneuverable, well meriting its half-derisive nickname "boxcar," but the Navy needed its range. Known as the PB4Y to the Navy, the Liberator may carry up to three-ton bomb loads, and it is armed with enough .50 caliber machine guns to make Jap fighters very cautious about coming in. At low altitudes the PB4Y's have no blind spots, and VB-109 never flew them high.

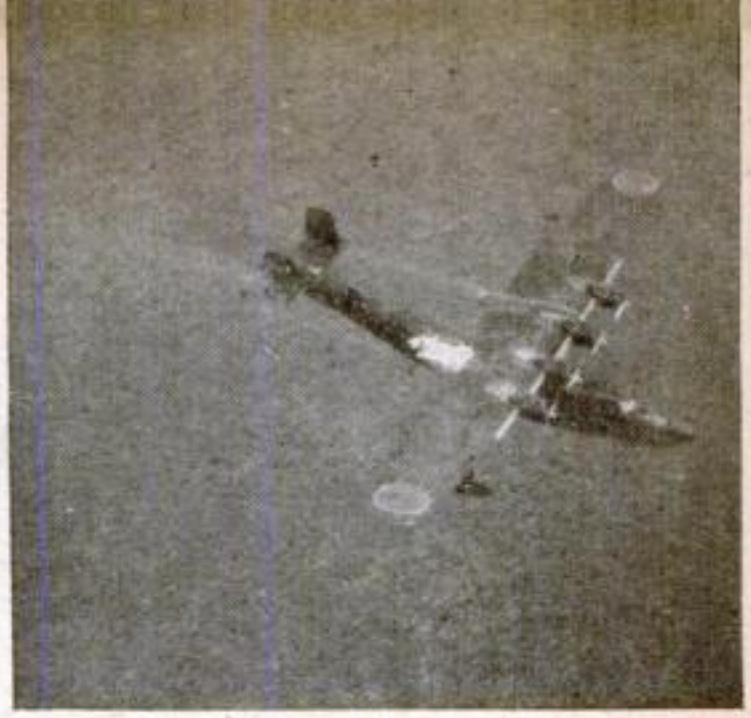
With the Mariners and Coronados and Catalinas, the Navy Liberators are the Navy's "1,000-mile eyes" and their job is search, patrol, and armed reconnaissance. They fly a lonely course for hundreds of miles out from their Pacific base and then back again, covering every wave in a great watery triangle of ocean. Every day eight of the big planes go out, each manned by a pilot and copilot, navigator, two radiomen, and six gunners. A thousand miles ahead of our forces, they have a look for Jap shipping and keep an eye on what's going on.

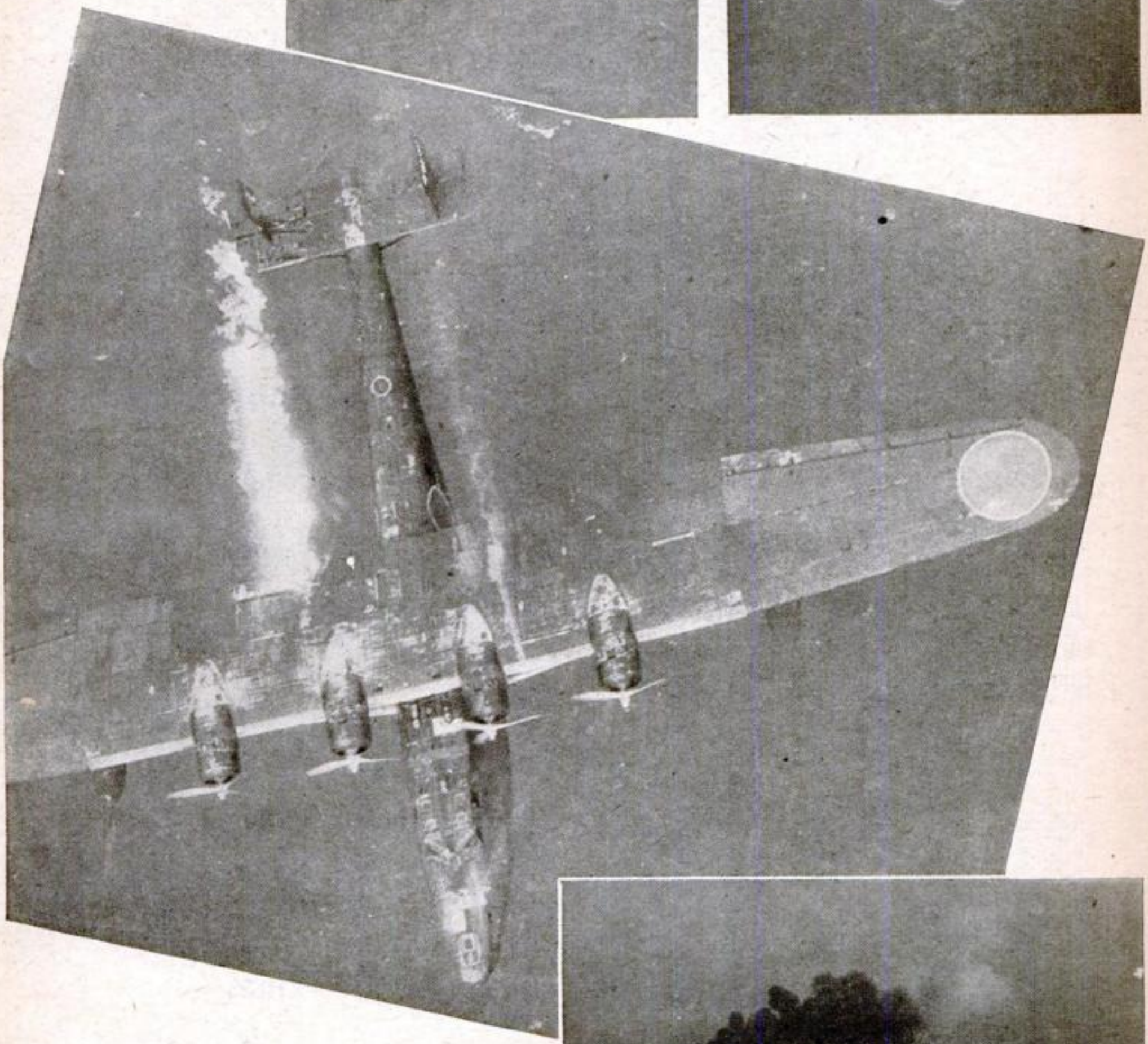
Their orders are to attack submarines and small enemy vessels in their area, to track and report the movements of larger enemy shipping, and occasionally to reconnoiter enemy-held islands and find out what the Japs are up to. Anything beyond following these orders is extra duty and can be undertaken on the individual pilot's initiative only if it doesn't interfere with the main job of search and patrol.

VB-109 flew more than its full share of the routine patrols, and, in addition to its regular duty, flew out of its assigned areas to make 352 attacks on enemy-held islands and bases. And, rather than track and report, it attacked every enemy ship it could find on these forays. One hundred and thirty-four Japanese *(Continued on page 212)*

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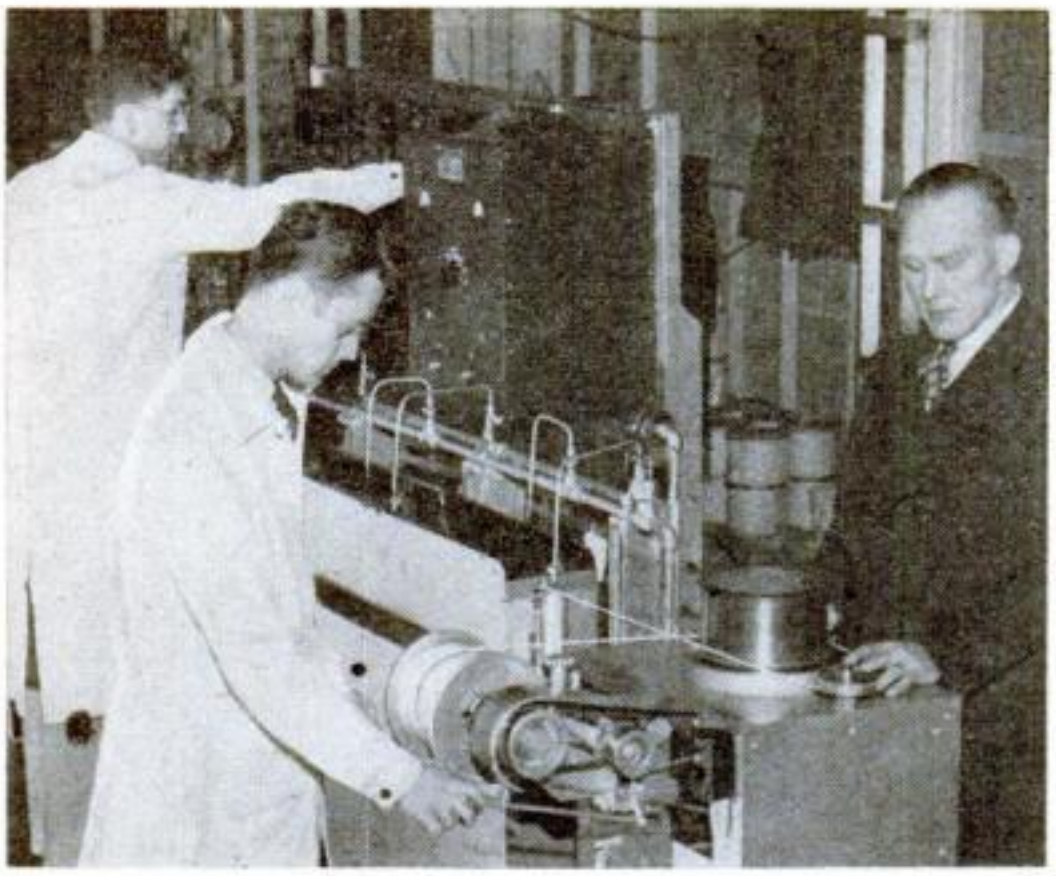




AND IN THE AIR . . . So formidable is the Liberator's armament of .50 caliber machine guns that Jap planes—even fighters—are leery of taking them on. As for bigger ships—the dramatic picture sequence on this page shows what happened to a Nip Mavis four-engine flying boat that engaged in a 19-minute game of tag among the clouds with a PB4Y piloted by Lt. John D. Keeling. Outmaneuvered at every turn, the clumsy enemy craft ended up as an oil slick. In a dogfight, one Liberator made such sharp turns that some of her own crew members actually blacked out

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March of Science



METALLURGY

ELECTROTINNING copper wire with greater speed and economy than heretofore possible is accomplished with a new wire-coating apparatus that uses the Du Pont halogen tin-plating solution. The naked wire passes through a series of baths to the take-up mechanism for the finished product shown at right. Wire as fine as .005 inch in diameter may be coated as fast as 800 feet per minute. Moreover, the new plating process requires only half as much tin as was necessary in the hot-dip method.

MEDICINE

AS EASY AS LYING is sitting up, for the patients in hospitals equipped with beds of the type shown below. The change in position is easily accomplished by means of a hydraulic control system similar to that which operates an airplane's landing gear. The controls are simple enough to be handled by the average patient who is not too ill to sit up, and eliminate adjustment of bed position through use of a hand crank. The photograph shows bed raised for sitting.



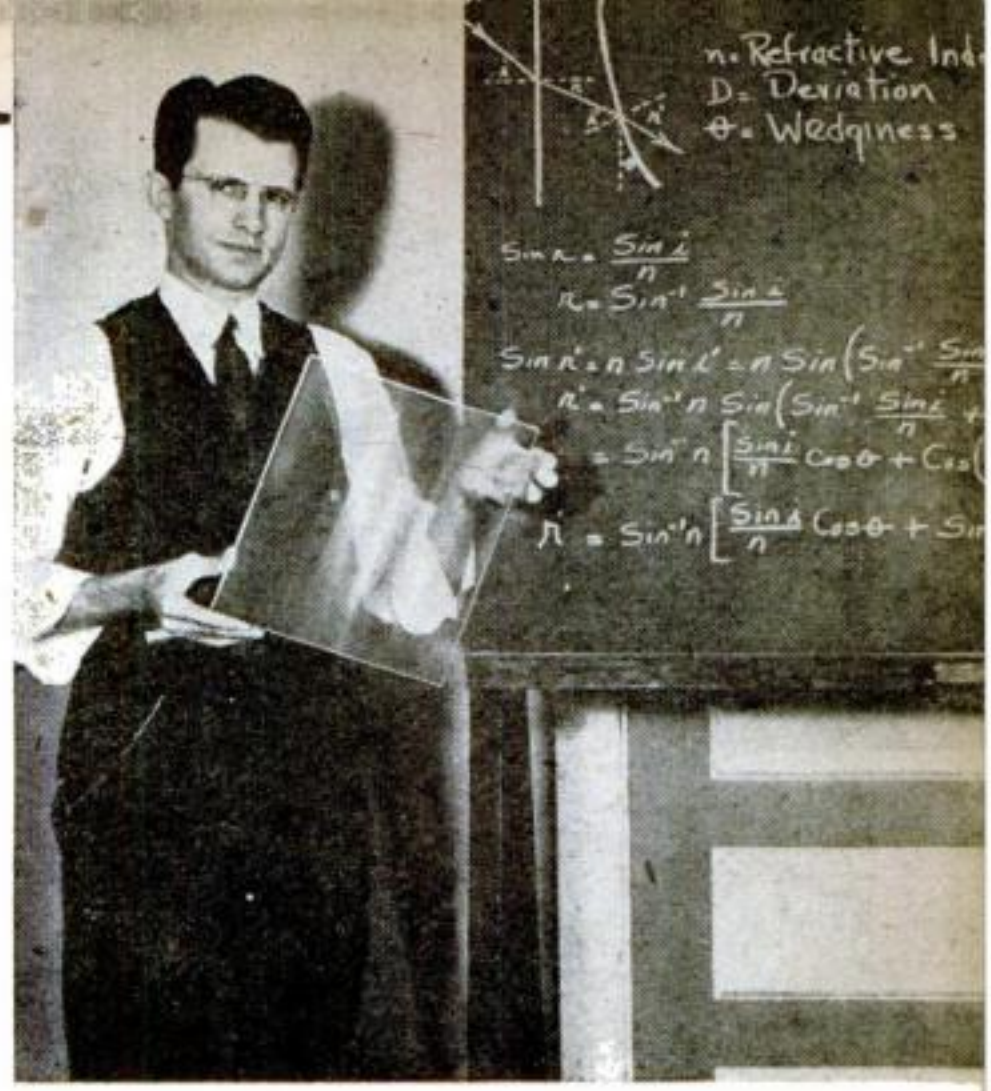


TEXTILES

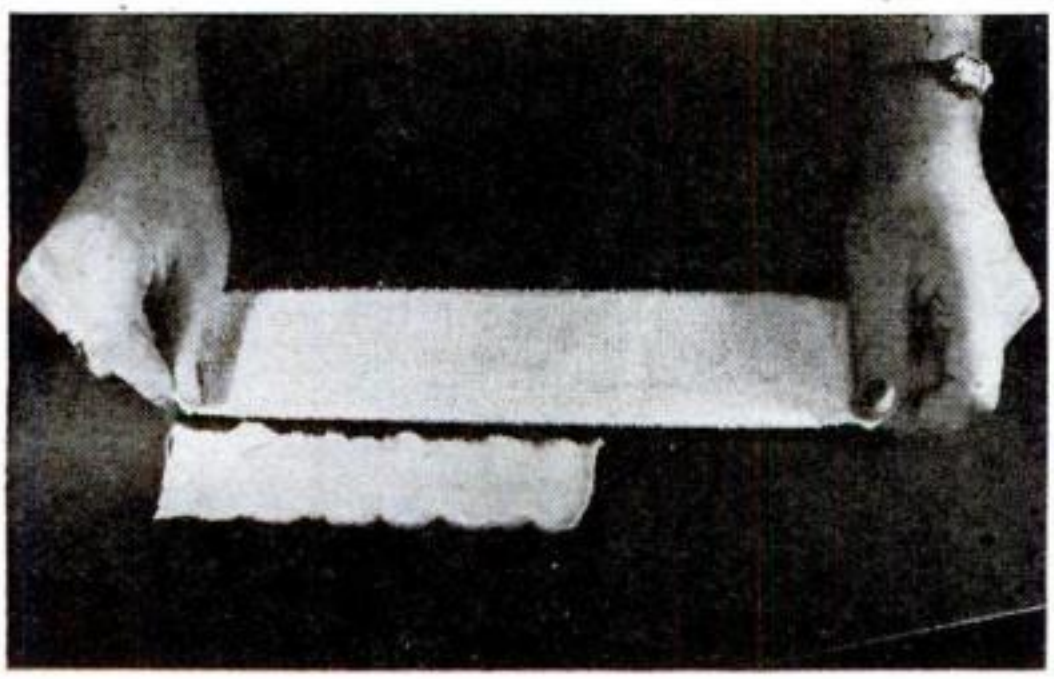
WRINKLE RESEARCH is being conducted by the young lady above to measure the effect of a crease resistant made by Tootal Broadhurst Lee Co., Ltd. She is proving that a snipping of a processed fabric branded as Tebilized recovers 75 percent from a five-minute creasing under a five-pound weight. The process consists of impregnating fabric fibers with urea formaldehyde, immersing in a bath of resin, and pressing between rollers to squeeze out excess resin and moisture. Other companies too, have processes designed to prevent shrinking, runs in stockings, and shiny pants.

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OPTICS



EQUATIONS MAY NOT BE CLEAR, but it's a different story with the glass held by Dale W. Rinehart, researcher at the Pittsburgh Plate Glass Co. It is a new type that will make it possible for aerial photographers to obtain accurate pictures from as great an altitude as 11 miles. From the complicated trigonometrical calculations illustrated, which involve refractive index, deviation, and the factor known as wedginess, Rinehart was able to originate the new glass. Formerly, a specially ground glass was used for the purpose, but it cost three times as much to produce as the new glass made by Rinehart's formula.



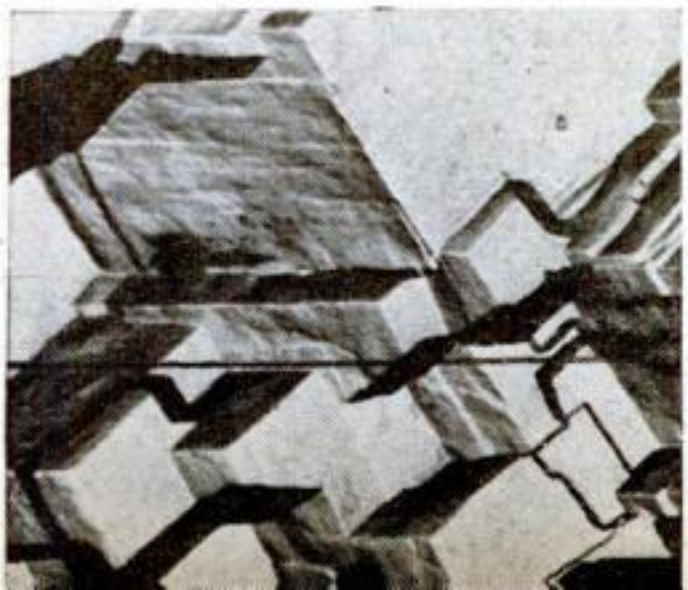
CHEMISTRY

NEW TYPE OF BANDAGE is made of Vinyon, elastic yarn that is a copolymer of vinyl chloride and vinyl acetate. It contains no rubber, keeps springy without frequent washing, and maintains constant pressure on the bandaged member. The bandage is made by Medical Fabrics, Inc., Paterson, N. J., and Becton, Dickinson & Co., Rutherford, N. J.

ELECTRONICS

NOTHING IS SMOOTH to the electron microscope, used by the Dow Chemical Co., Midland, Mich., to study corrosion phenomena in magnesium alloys. When images are enlarged 100,000 diameters on a three-dimensional Polaroid vectograph, such pictures reveal the shape of ultramicroscopic crystals of which various metals are composed. Thus it is now possible to investigate the shape and space characteristics of minute structures. The technique of examination involves the preparation of replicas, or the reproduction of the surface structure in a thin film of material suitable for use in the transmission type of electron microscope. Below are shown micrographs that were made from such replicas. Knowledge so acquired may be put to good use in developing new and better alloys.

A micrograph of aluminum oxide impression from opaque aluminum



A 9,000-diameter enlargement of a silica replica of an etch pit in pure zinc

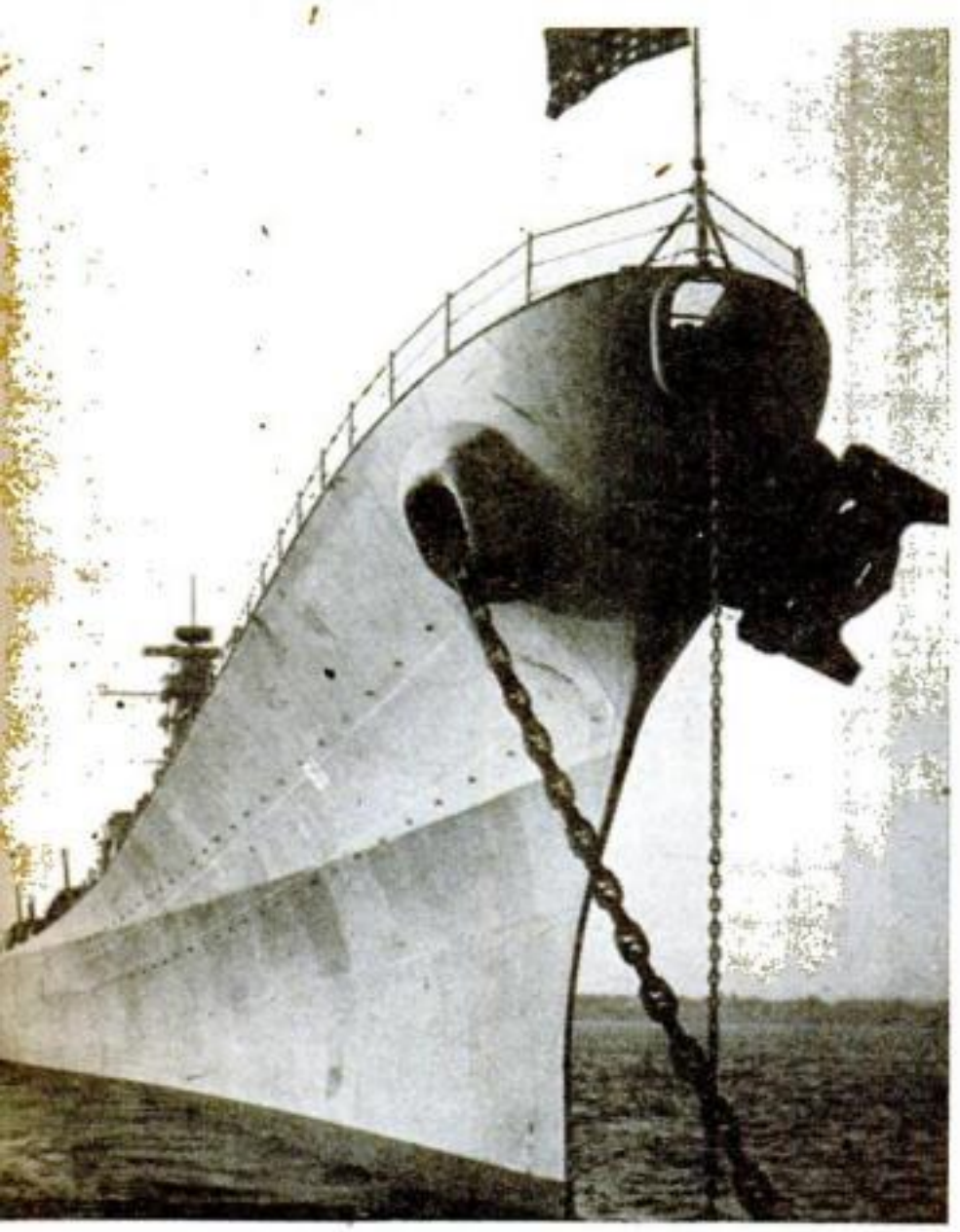


Silica-replica enlargement of physicist's diffraction grating





THE BATTLESHIP *IOWA*, as seen in the first profile view made public by the Navy. Unprecedented speed, mighty surface and antiaircraft armament, and almost impenetrable armor make the six *Iowa*-type men-of-war the most powerful class of fighting ships in the world. Externally, exceptionally long decks of the



UPSWEEP of the *Iowa's* forecastle makes it a real climb to reach the overhanging bow. Massive port anchor is seen at extreme right; the starboard anchor is down

WATERLINE, streamlined for speed, exhibits some odd curves when viewed from the surface right alongside



I Cruised on the IOWA

A Popular Science reporter and cameraman bring you a first-hand picture of life and action aboard the world's mightiest fighting ship.

Bzz . . bzz . . bzzz—"

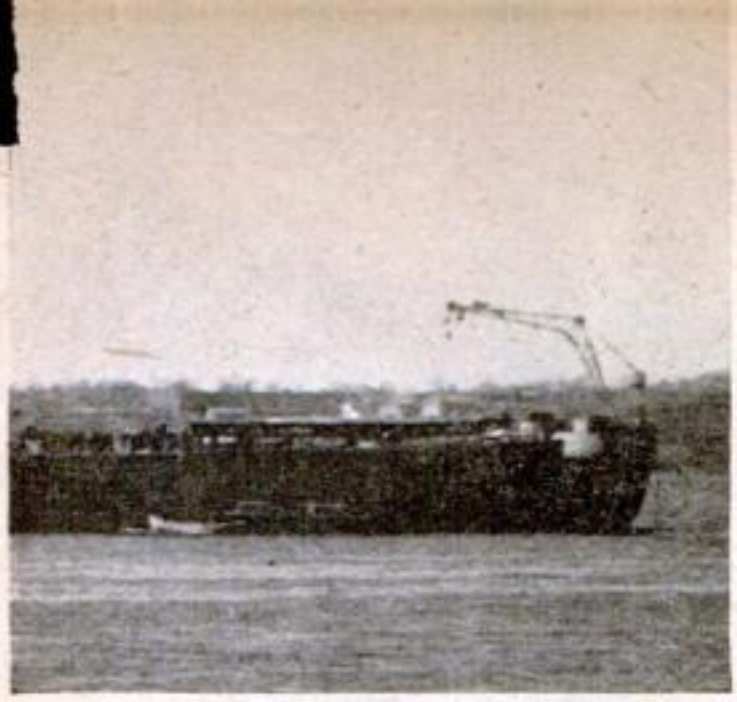
The 45,000-ton U.S.S. *Iowa,* mightiest battleship ever built, cleaves gray-green Atlantic waters at top speed. A red flag surmounting a signal halyard tells fishing smacks to stand clear. And through wads of cotton stuffed in the ears of sailors and landlubbers, bunched near the prow, filters the penetrating sound of a buzzer. It warns that the ship's main battery of nine 16-inch guns is about to fire a broadside.

Squarely in the middle of the long buzz comes the thunderclap. Spurts of flame dart from the muzzles of the giant rifles. Billows of orange smoke follow. The brutal force of the explosion seems to cave you in —as if you had suddenly been struck a physical blow from all sides at once. Like a living thing, the ship itself quivers beneath you. Reverberations of the blast echo back to your ears for perhaps 20 seconds.

At night, the shells themselves become the center of the display. Coated with a bright-red tracer compound, they resemble Chinese lanterns floating through the air, as they rise from the ship and descend into the sea far away. Traveling together in groups of three from each turret, the fireballs trace parabolic arcs in perfect alignment, testifying to the mathematical precision of the guns that launched them.

Photo at left and all except two bottom pictures on pages 82 and 83 by Robert F. Smith. Others Official U. S. Navy.

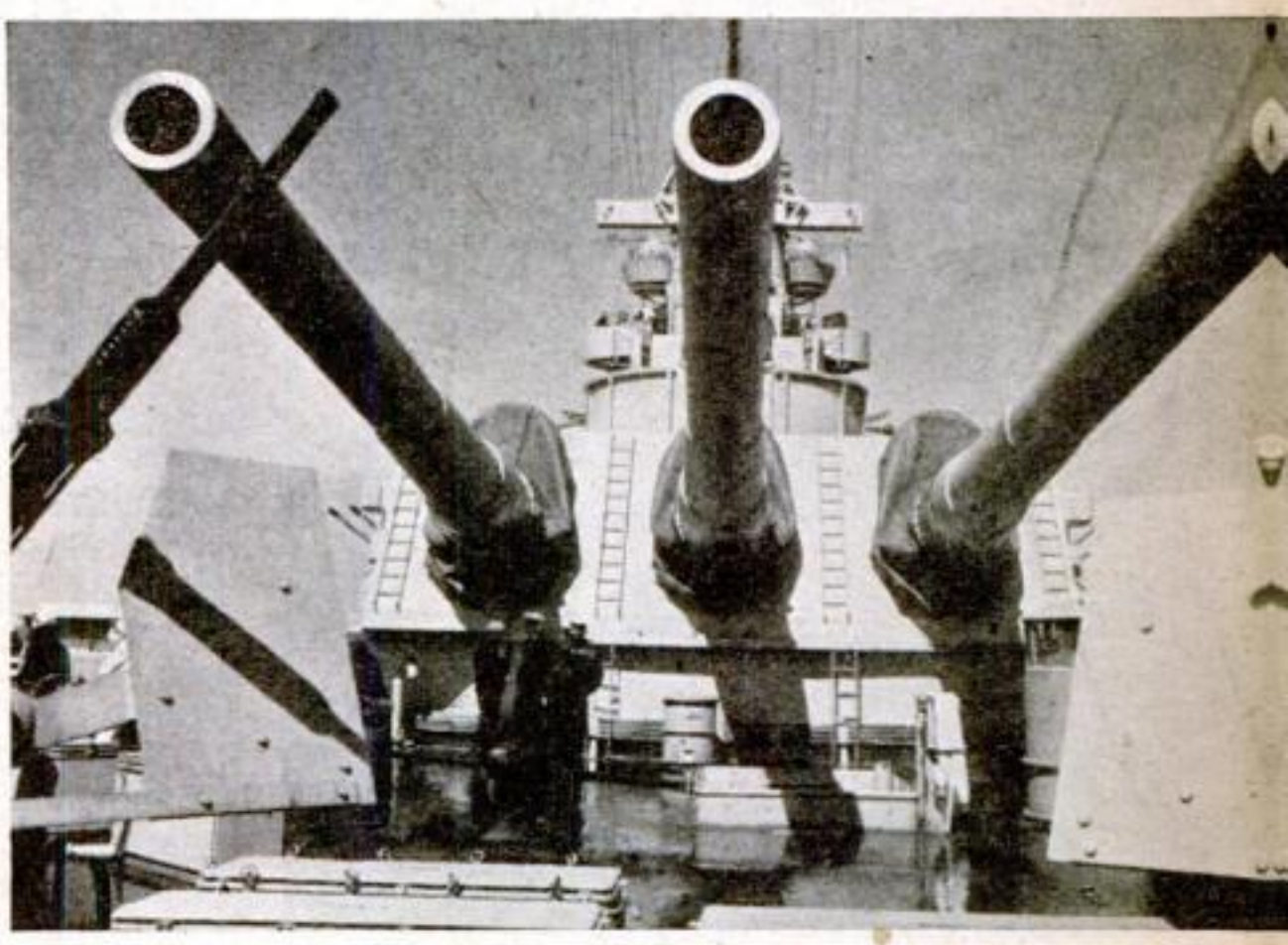
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45,000-ton *Iowas* distinguish them in appearance from the six smaller battleships of the *North Carolina* class

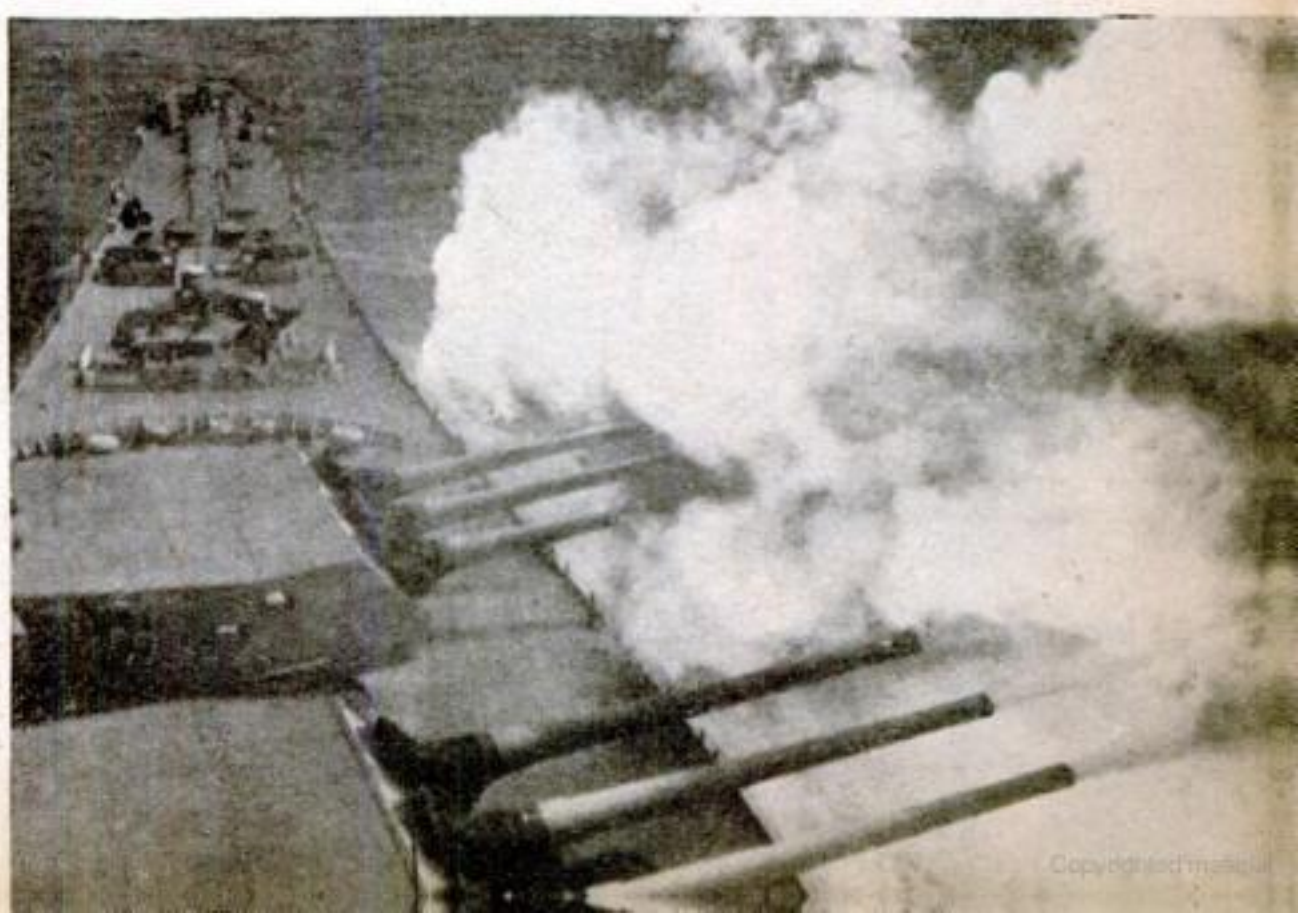


FORWARD TURRETS hold six of the *Iowa's* nine 16-inch guns. They can be rotated to fire forward, broadside, or within a few degrees of dead astern. The second turret fires forward across the other's top



AFT GUNS, in a single turret, complete the main battery. This arrangement of guns and turrets is standard on modern U. S. battlewagons

SALVO! This is how the *Iowa's* 16-inchers look when they let go. How they sound can't be pictured. These are the six guns in forward turrets



Awe-inspiring spectacles like these highlighted a week that I spent with Bob Smith, POPULAR SCIENCE cameraman, aboard the most gigantic fighting machine that man has yet devised. The occasion was the shakedown cruise of the *Iowa,* name ship of her class of six battleships. Since then, the Navy announces, the 880-foot battlewagon has been making things hot for the Japanese.

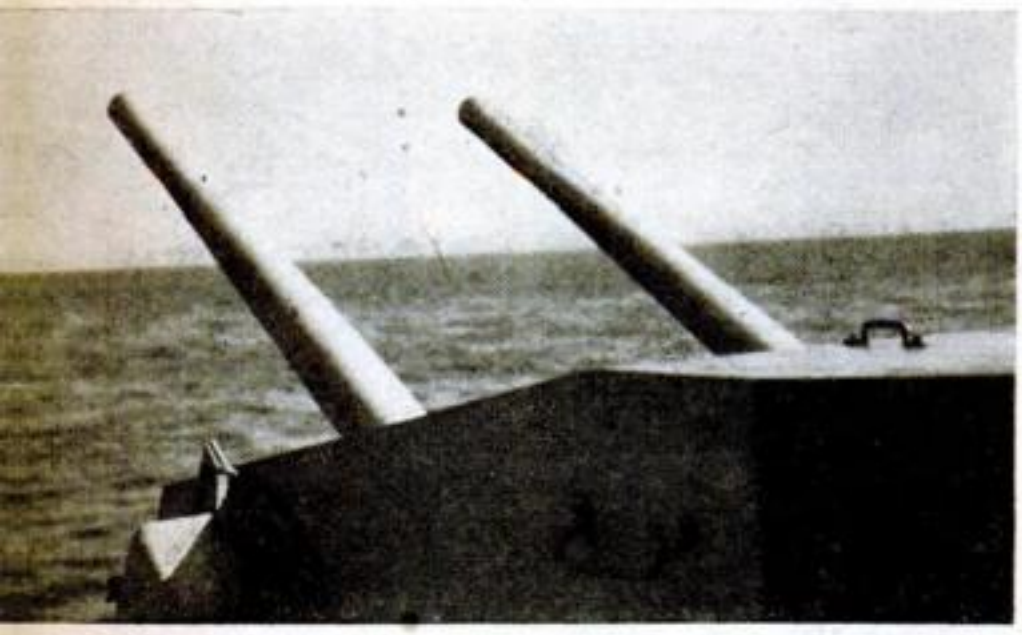
With so little vibration that we never noticed it—though engineers were checking it with instruments like miniature seismographs—the *Iowa* glided from her New York anchorage and headed north, during the evening meal or shortly after.

Scrambling from our cots at dawn, we found the battlewagon about to drop anchor at Portland, Me. Our early-morning arrival amazed me. Aided by a speed test, the vessel made the trip within a few hours of fast train time.

According to the U. S. Navy's official and conservative figure, the *Iowa* makes "30-plus" knots, the highest speed ever built into an American capital ship. Just what that "plus" amounts to, the enemy will not learn here. But the *Iowa's* total of 200,000 horsepower, nearly twice the horsepower of the 35,000-ton *North Carolina* class, shows clearly that many of her extra 10,000 tons have been invested in the power plant that drives her. The



LIKE PORCUPINE QUILLS, Oerlikon 20-mm. automatic cannon bristle from the decks to fire 400 rounds a minute apiece at enemy planes coming in half-mile range. The fishlike object at the left in the photo is a paravane, designed to be trailed outboard to sweep submarine mines from the ship's path

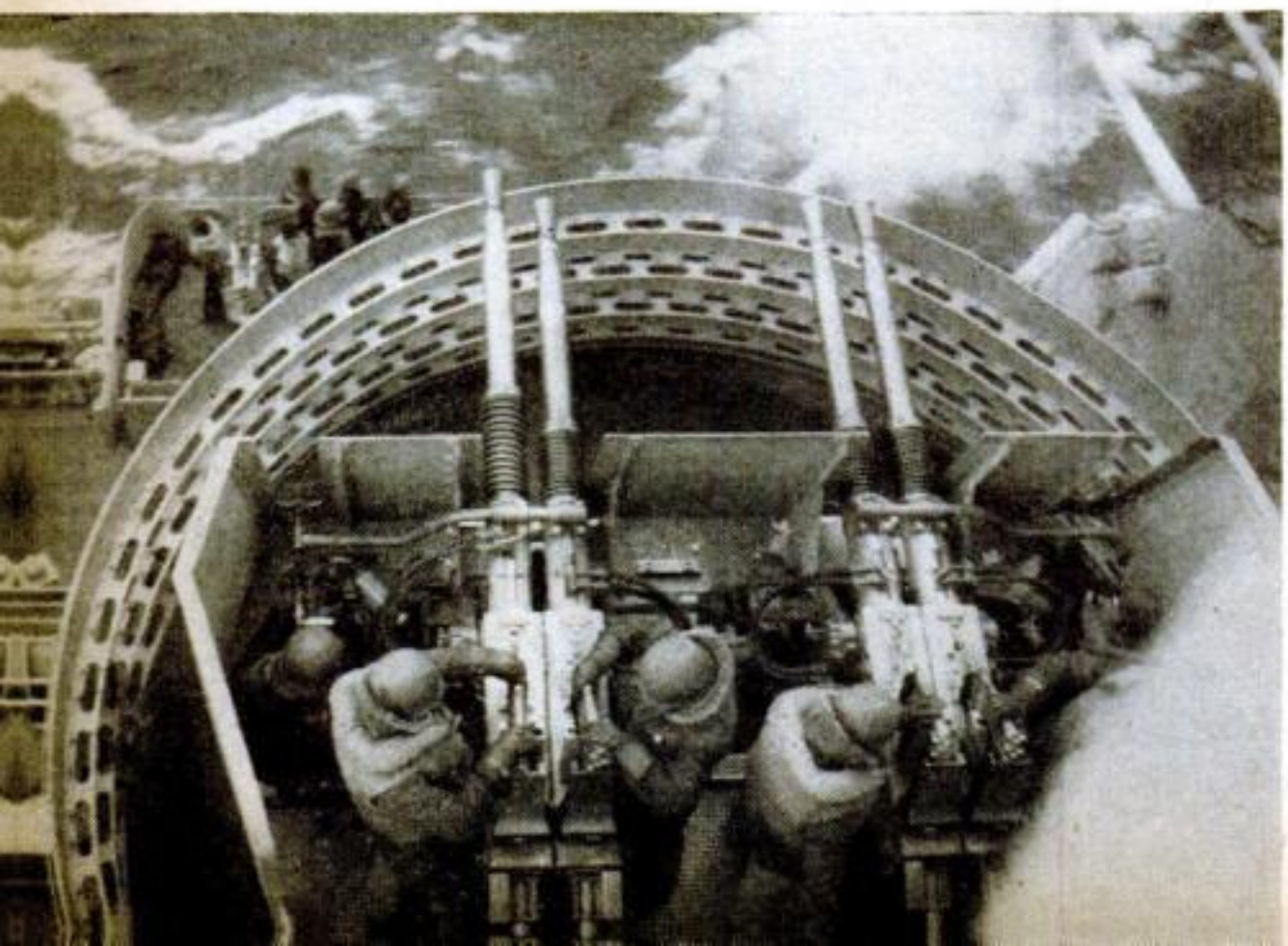


DUAL-PURPOSE five-inch guns can be depressed to deal with hostile destroyers, or elevated to high angle to bring down aircraft from altitudes up to 1½ miles

first U. S. warship to be designed with the aid of the Navy's magnificent new model-testing basin at Carderock, Md., the *Iowa* gets the most out of her propelling machinery. The curious curves of her streamline hull part the water with scarcely a ripple, and only the deck-high spray of spume from her four propellers testifies to the tremendous forces harnessed in her high-pressure, high-temperature turbines.

Guns of the main battery, in the *Iowa* class, follow the number, size, and arrangement found eminently satisfactory on the *North Carolinas*. Six of the 16-inchers are mounted forward and three aft, all in triple turrets. They constitute at least a match for the gun power of any ship afloat—equaling the nine 16-inchers on Britain's four ships of the 40,000-ton *Lion* class, and also the nine 16-inchers said to arm Japan's reported new battleships of 40,000 tons or more. Only these two naval powers have or are believed to have battleships approaching the might of the *Iowa*, her three

(Continued on page 222)



QUADRUPLE BOFORS

Standard in-between size, these AA guns of 40-mm. caliber (about 1.6-inch) fire 120 shells a minute each. Flared muzzles mask the flash so that gunners will not be blinded at night. Slots in shield hold shell clips

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BATTLE DOORS. Every one of the *Iowa's* 1,857 doors, hatches, and manholes is marked with a *W, X, Y,* or *Z.* Security dictates which can be opened in safe harbor, at sea, when action is imminent, and in battle. This is to limit damage by fire, flooding and explosion

BATTLE PHONES (below) transmit orders to gun crews and elsewhere during engagements. Installations at key points give instant two-way communication with command posts. If battle damage breaks a connection, other circuits are available for use

To use the battle phone, a crewman merely unscrews a weatherproof plate from an instrument like that below and plugs his headset into what looks like the mouthpiece of an ordinary phone





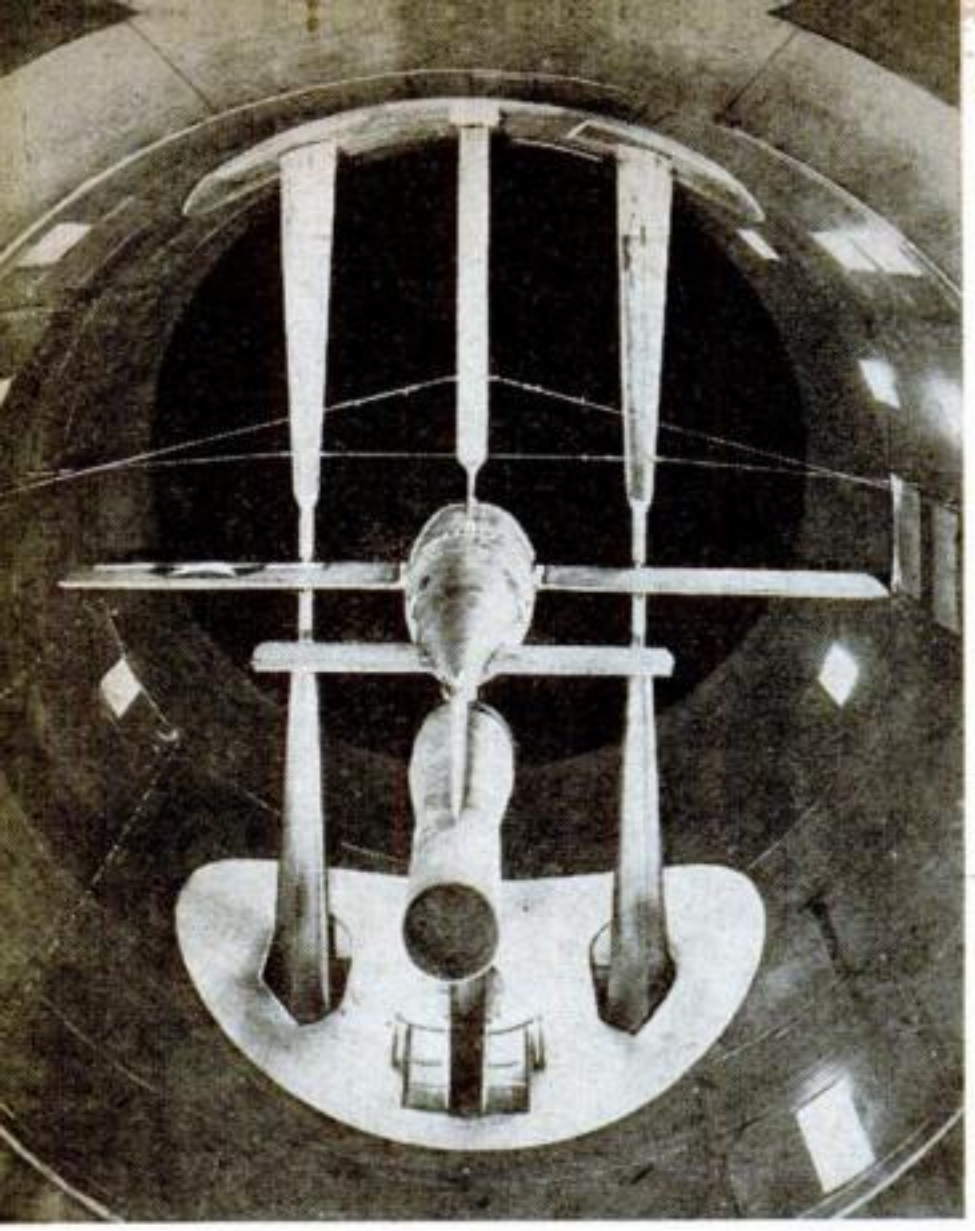


PERISCOPES supplement narrow-vision slits to give telescopic views from heavily armored navigating and fire-control stations. This is a skipper's-eye view of the U.S.S. *New York,* a veteran of World War I fame, as seen from the new *Iowa*

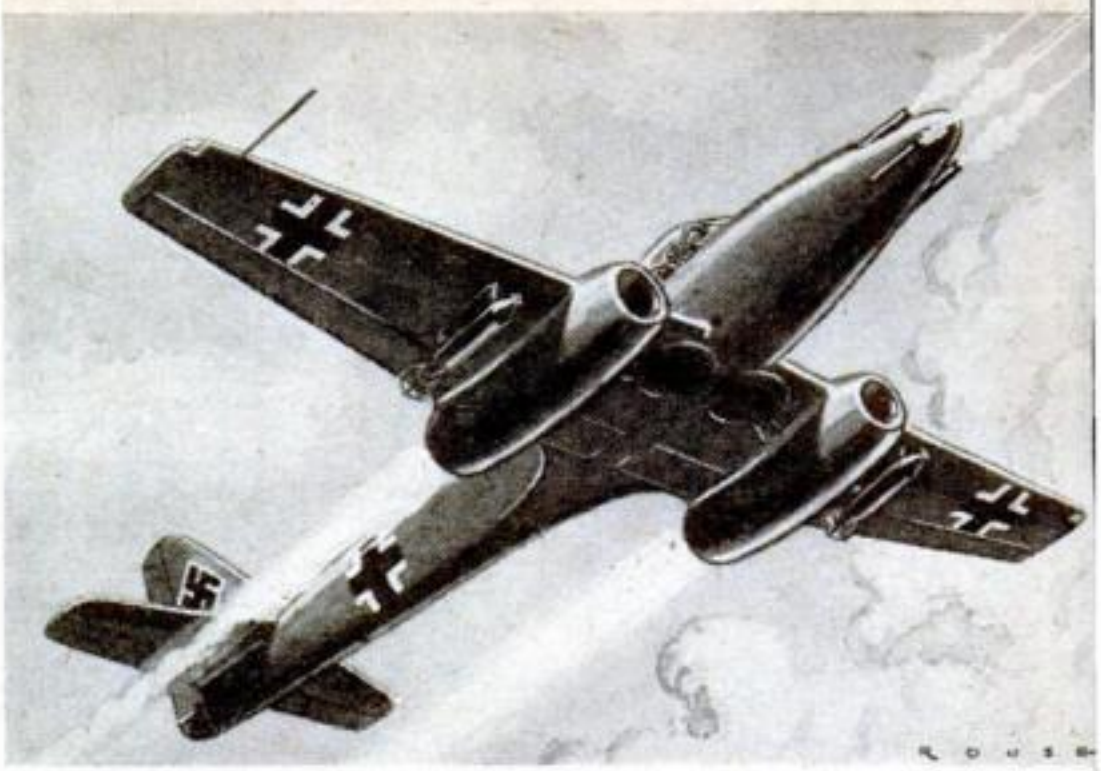
IOWA'S EYES are these three seaplanes, which nest on the afterdeck. One is shown taking off into the wind from a catapult with a boost from an explosive charge, while another is poised on a second launching track. In battle they spot artillery fire, enabling the big ship to slug it out with an enemy beyond the horizon. Returning, they alight on the water and taxi alongside, to be lifted aboard by crane

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What's New

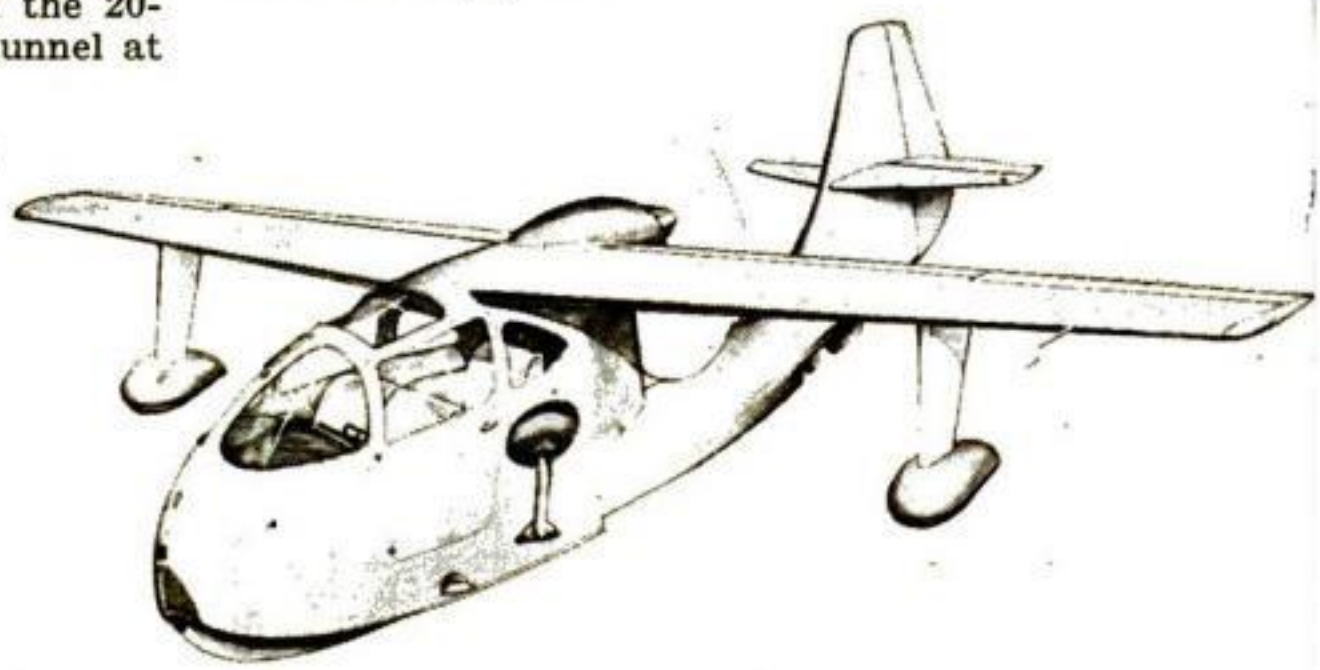


WE HAVE BUZZ BOMBS, TOO. Fully 10 American war plants are turning out replicas of the Nazi V-1 robot bomb for use primarily in designing defenses against such weapons. It is conceded that, while they may be used only for experiment, practice may include use against the Japs in the Pacific. Above is one being tested in the 20-foot, 700-mile-an hour AAF wind tunnel at Wright Field, Ohio.



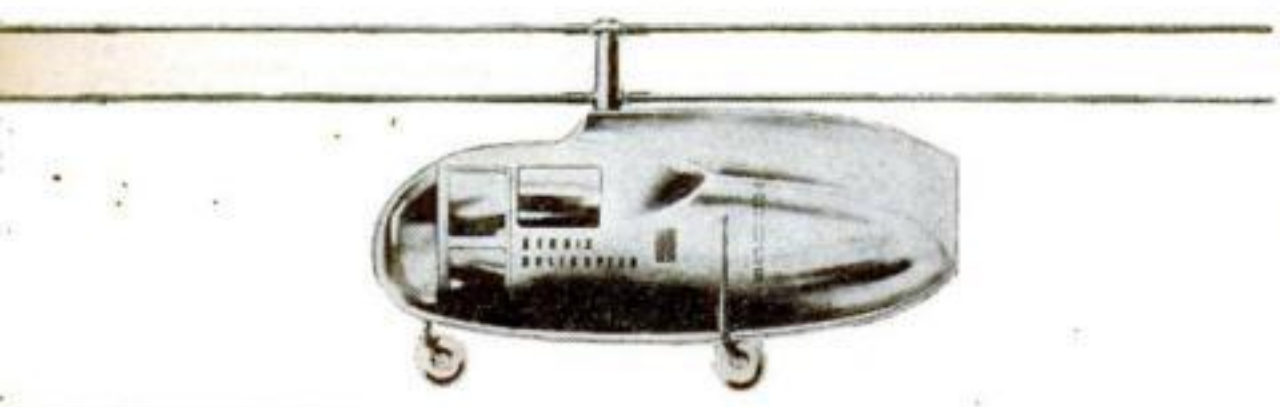
GERMAN SQUIRT PLANE was used in action against the Allies in Belgium and Holland. This jet-propelled single-seat fighter is the Messerschmitt ME-262, and is powered with two Junkers Jumo 004 jet power units and armed with four 30-mm. cannon. Planes of this type, fitted with bomb racks, were hurled by the Luftwaffe against invasion troops in the low countries. To some extent the plane resembles our own Bell P-59 Airacomet, further information about which may be found in POPULAR SCIENCE MONTHLY, April '44, p. 85, and Nov. '44, p. 83.

FAMILY THUNDERBOLT for after-war junketing is an all-metal four-place flying boat with a 175-hp. six-cylinder engine. Specifications for this Republic "Thunderbolt Amphibian" include a maximum speed of 120 m.p.h. and a cruising speed of 105 m.p.h. Span is 36 feet and gross weight 2,600 pounds; price probably under $4,000.





TOP VIEW



SIDE ELEVATION

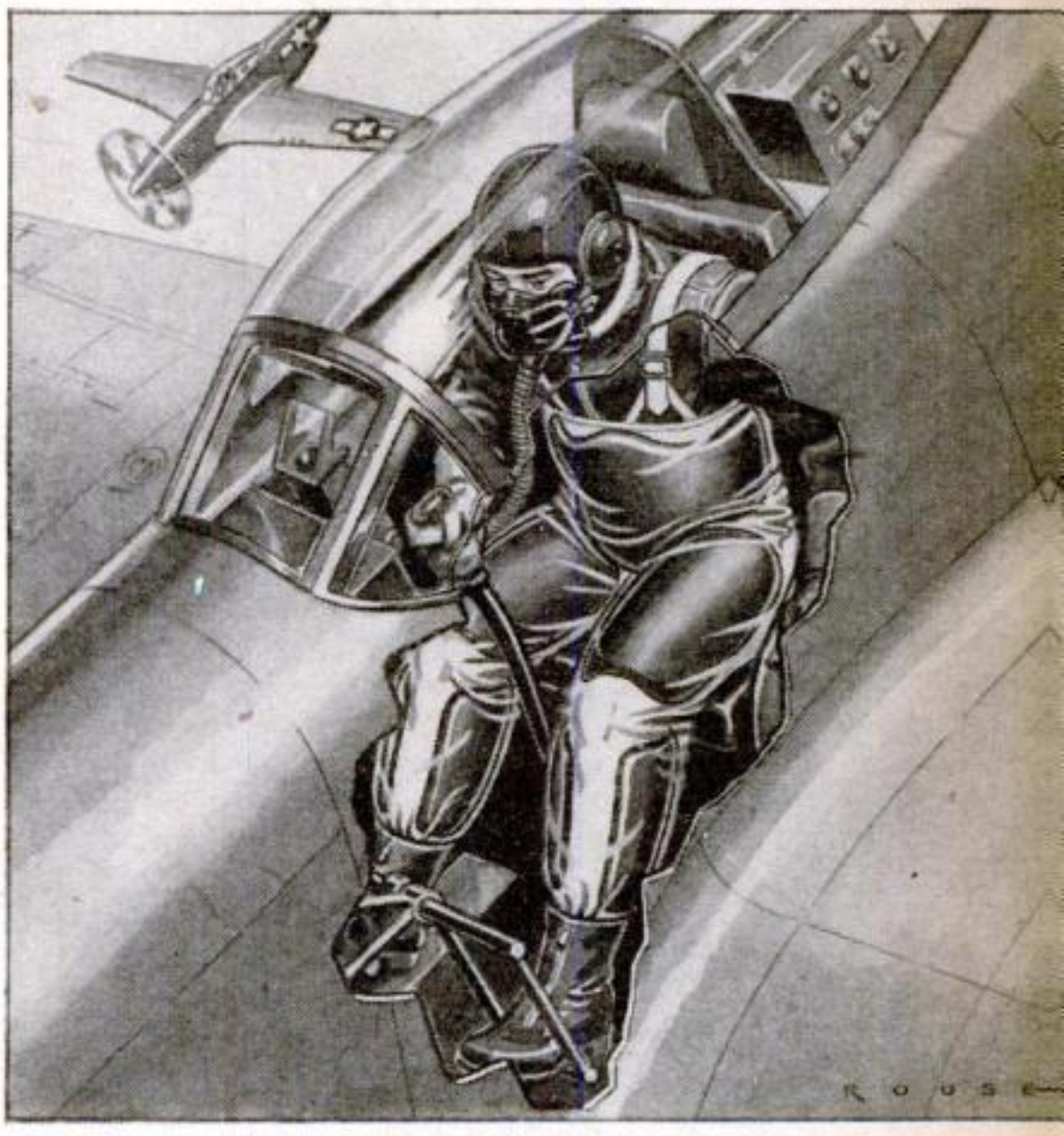
BENDIX HELICOPTER. This four-passenger sedan is announced as the first postwar model of a radically new helicopter design developed by Vincent Bendix, famous inventor and president of Bendix Helicopter, Inc. Simplified controls are said to make it as easy to operate as an automobile. Contra-rotating two-bladed rotors solve the problem of torque, and there is no cyclical pitch change to cause noise and vibration. Top speed is about 140 m.p.h.

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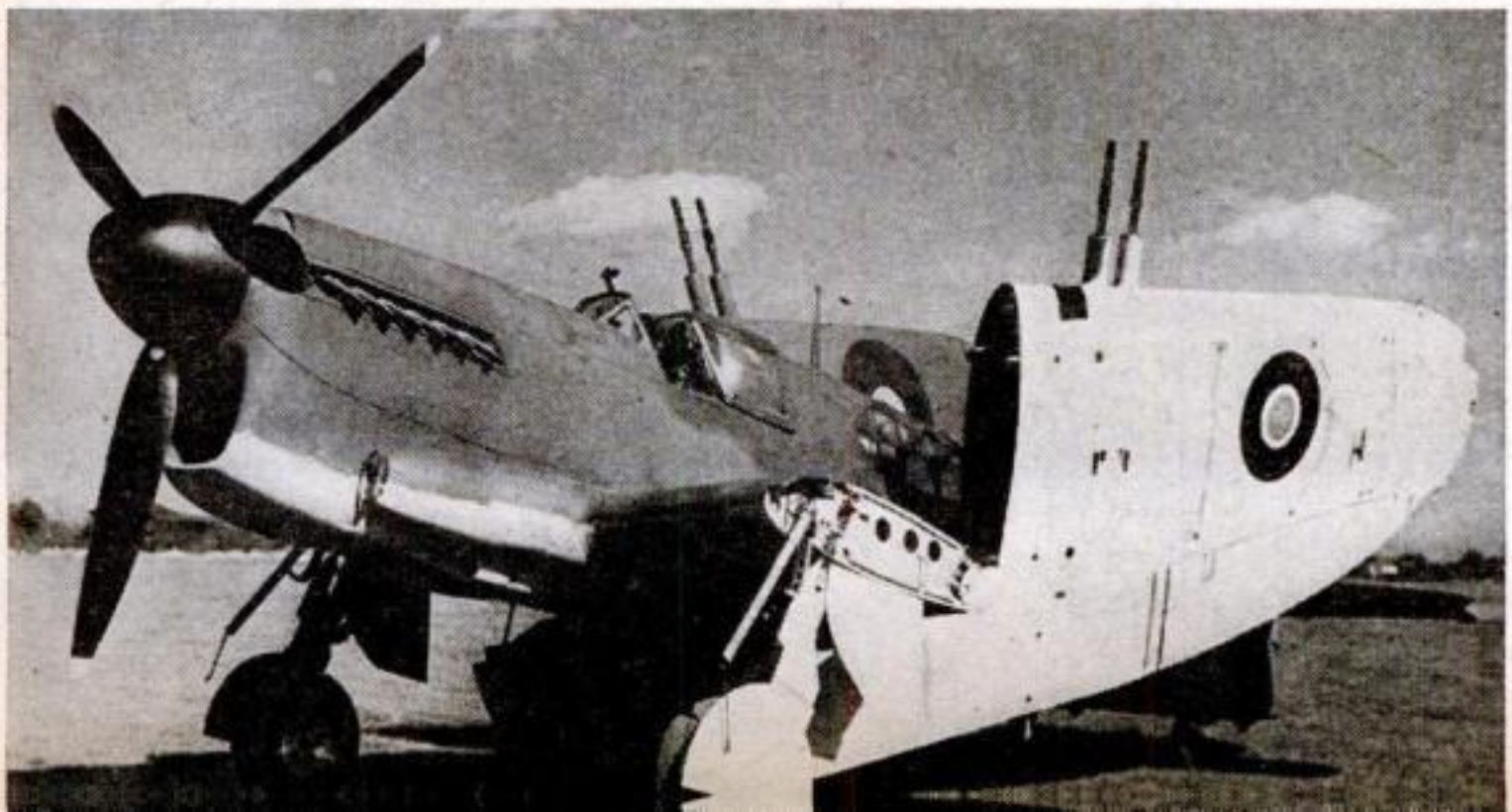
in Aviation



NEW FAIRCHILD PACKET, the C-82, is a giant twin-tail-boom cargo plane with a range of 3,500 miles and a capacity of 75 passengers. It can carry military equipment, including tanks and fieldpieces, and is also designed for glider towing and paratrooper use. As a postwar passenger plane, it can accommodate 30 night passengers in upper and lower berths on both sides of the the aisle, or 50 passengers in reclining chairs.

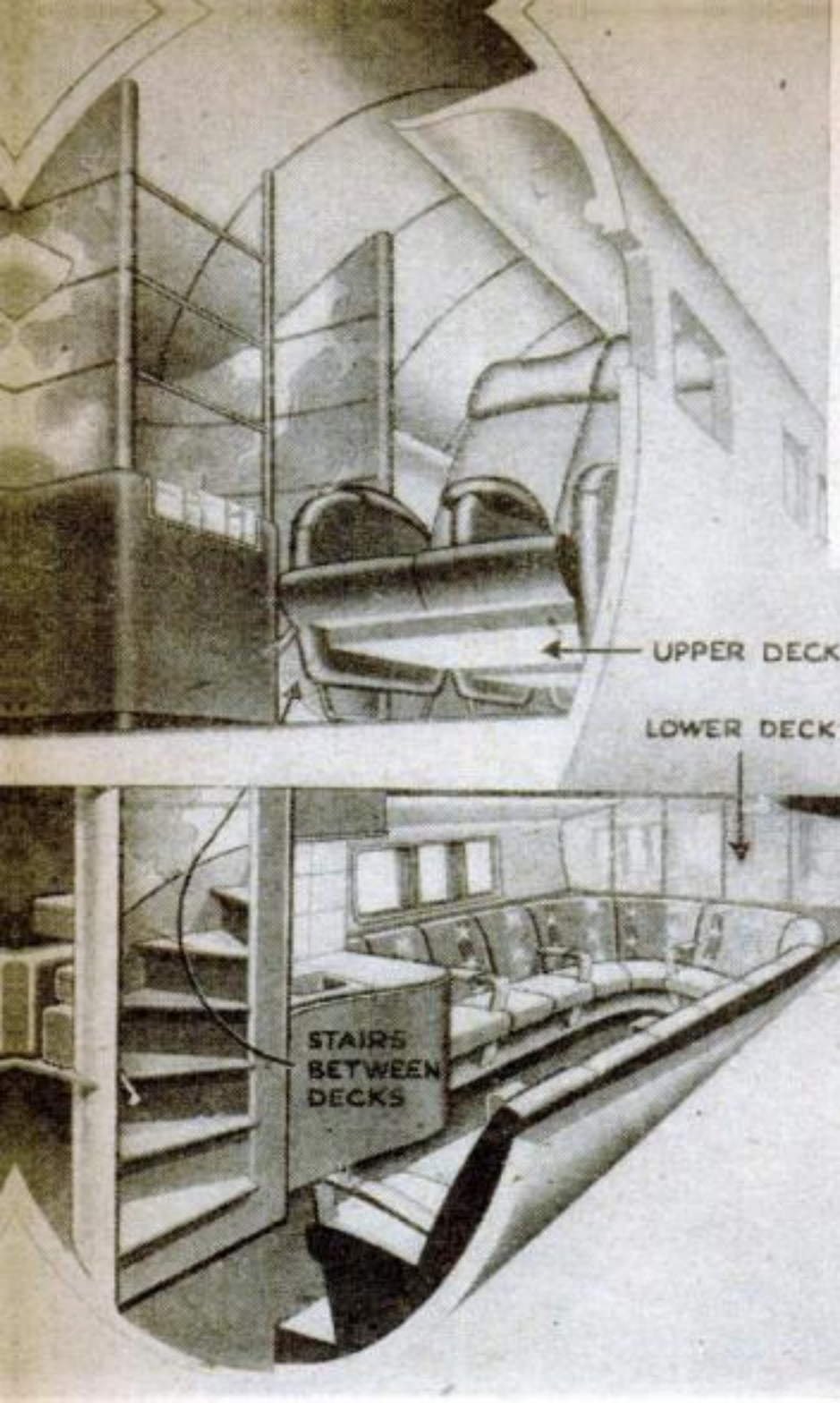


GRAVITY SUIT worn by fighter pilots minimizes blackouts by application of air pressure during a pull-out. According to the *Army and Navy Journal,* pressure in the suit, which resembles tight, high-waisted pants with built-in suspenders and girdle, is supplied by air bladders over the abdomen, thighs, and calves. The bladders are inflated from the aircraft's vacuum instrument pump. An automatic valve requires only two seconds to inflate or deflate the bladders in accordance with changes in centrifugal pull.

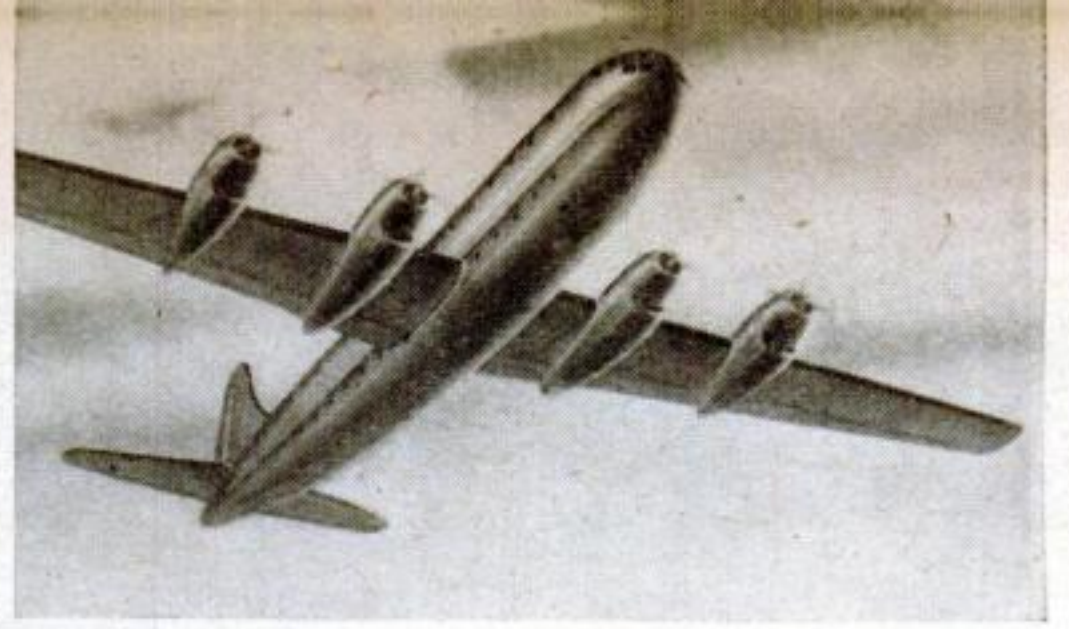


FAIREY FIREFLY. This new British fighter-reconnaissance plane for carrier use in the Pacific packs four 20-mm. cannon in the wings, which fold backward for shipboard storage. Pilot and observer in separate cockpits operate the guns and an aerial camera. The span is 44½ feet and the length 37 feet. It has a 12-cylinder engine.

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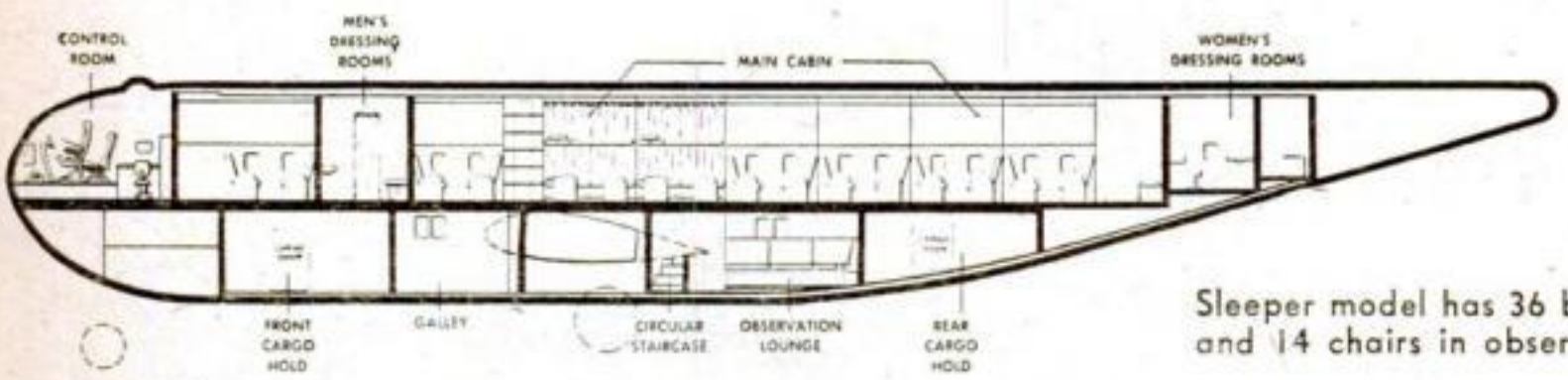
Addition of an upper deck to the B-29's fuselage gives a cross section the shape of an inverted 8, doubles the cubic capacity, and permits installation of adequate cabins and lounges for travelers



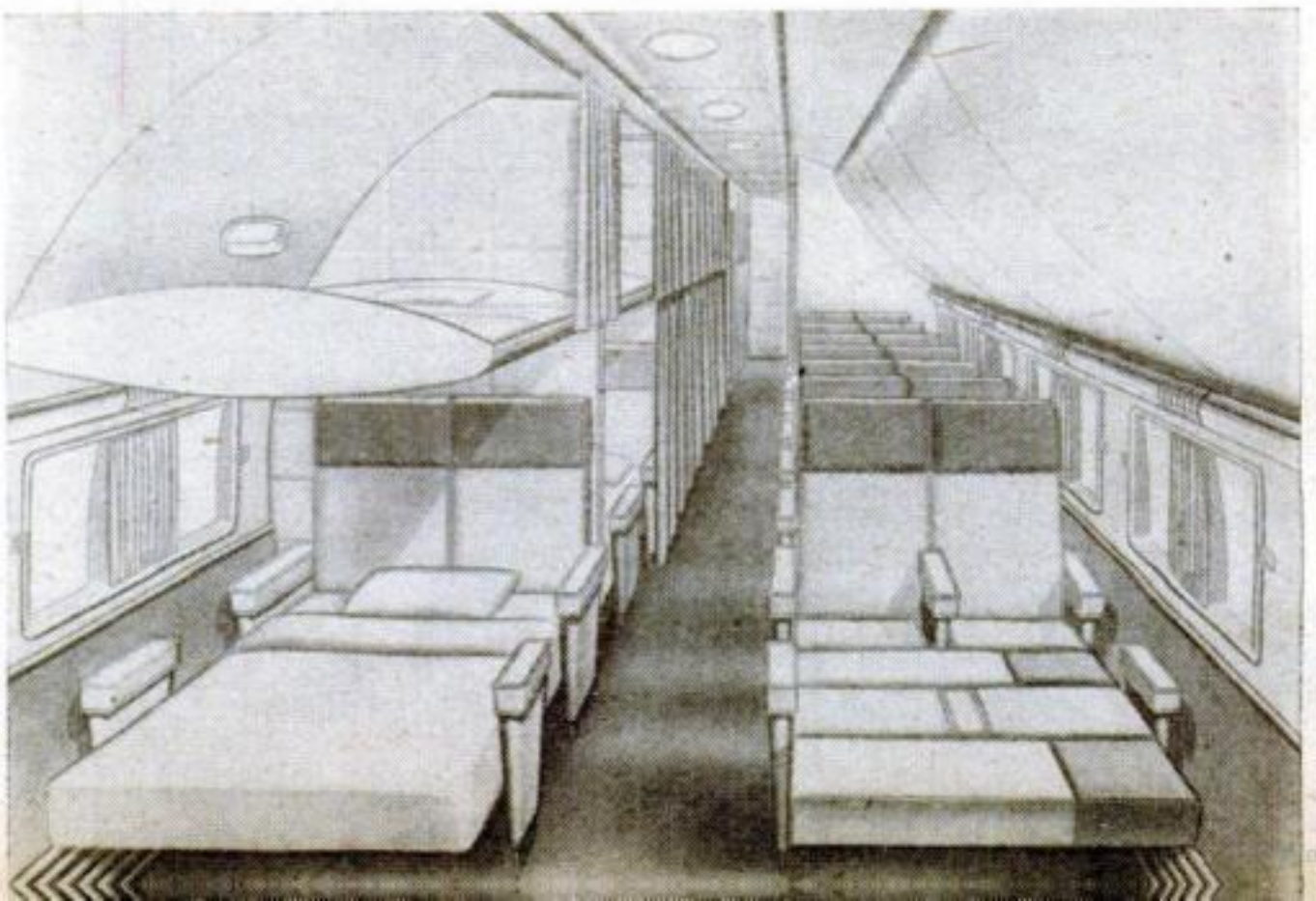
The Stratocruiser will cruise at 340 miles an hour with 100 passengers or 35,000 pounds of freight

B-29 Groomed as Postwar Airliner

B-29's ADAPTED for commercial use may cut the fare across the U. S. to $40 or $50, and from New York to London to between $60 and $90. The Boeing 377 Stratocruiser is the first superliner of the future actually built, a military transport version having been completed for testing. It has 14,000 horsepower for take-offs, over twice as much as a powerful railroad locomotive. Wings, tail surfaces, landing gear, and lower part of fuselage are exactly like those of the Superfortresses that have raided Japan. Gun blisters are eliminated to increase the streamlining. The cargo version has winches and other devices with which freight can be loaded and stowed swiftly and economically.



Sleeper model has 36 berths on upper deck and 14 chairs in observation lounge below



Seats are converted into roomy berths in one of several proposed interior plans for supertransports that can fly any air route on earth. Cabin space equals that of two railroad coaches. Pressurizing allows for altitude of 30,000 feet





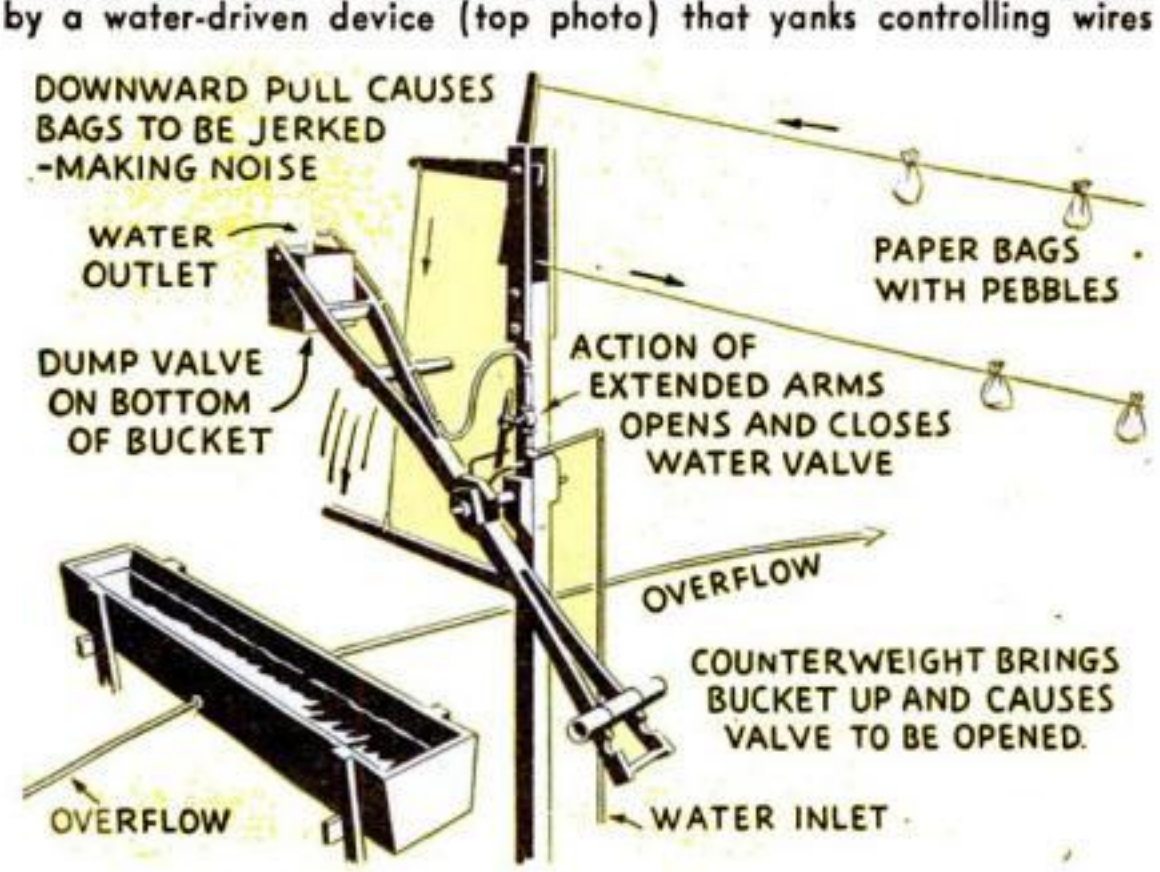
WATER ANIMATES SUPER SCARECROW

A MULTIPLE mechanical scarecrow that would be likely to frighten the daylights out of any living creature that happened to wander into its vicinity has been devised by Harry Boynton, of the Boynton Beam Laboratories, Hollywood, Calif., to protect his berry crop. Having learned that crows and other fowl are now too sophisticated for the old-fashioned stuffed suit, he has brought science to bear on his problem and produced a super scarecrow operated by water power. The result was shown in a recent "Popular Science" film produced by Jerry Fairbanks in co-operation with POPULAR SCIENCE MONTHLY.

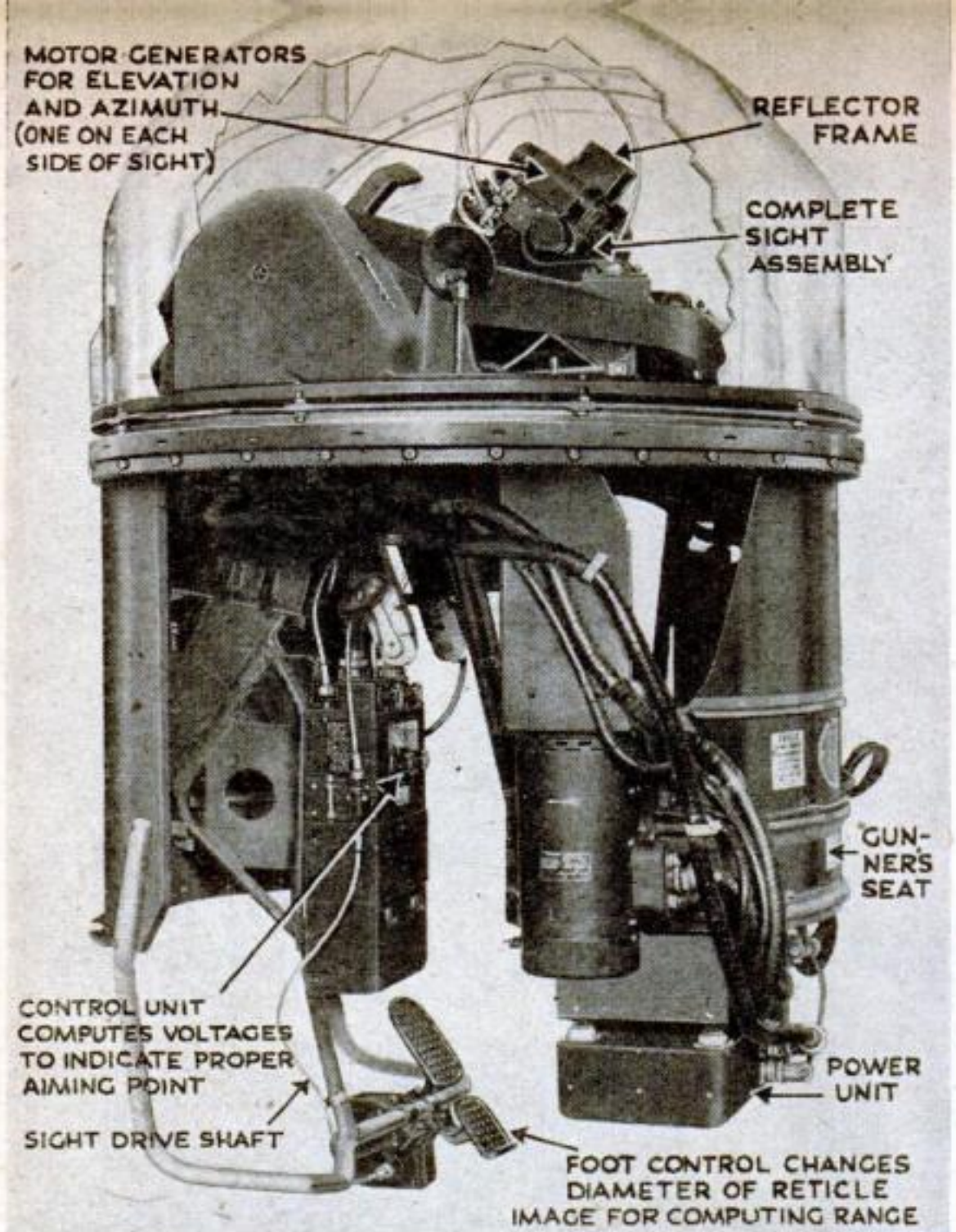
Covering about an acre, dozens of paper bags, each blown up and provided with a handful of pebbles, are suspended at intervals from wires strung some four feet above the ground over the entire patch. The motion is not supplied by chance breezes, but by a water-powered walking beam—a sort of mechanical rocking horse—that goes into action through the filling and emptying of a bucket. It works 24 hours a day.



Bird-scaring bags of pebbles strung above berry patch are shaken by a water-driven device (top photo) that yanks controlling wires



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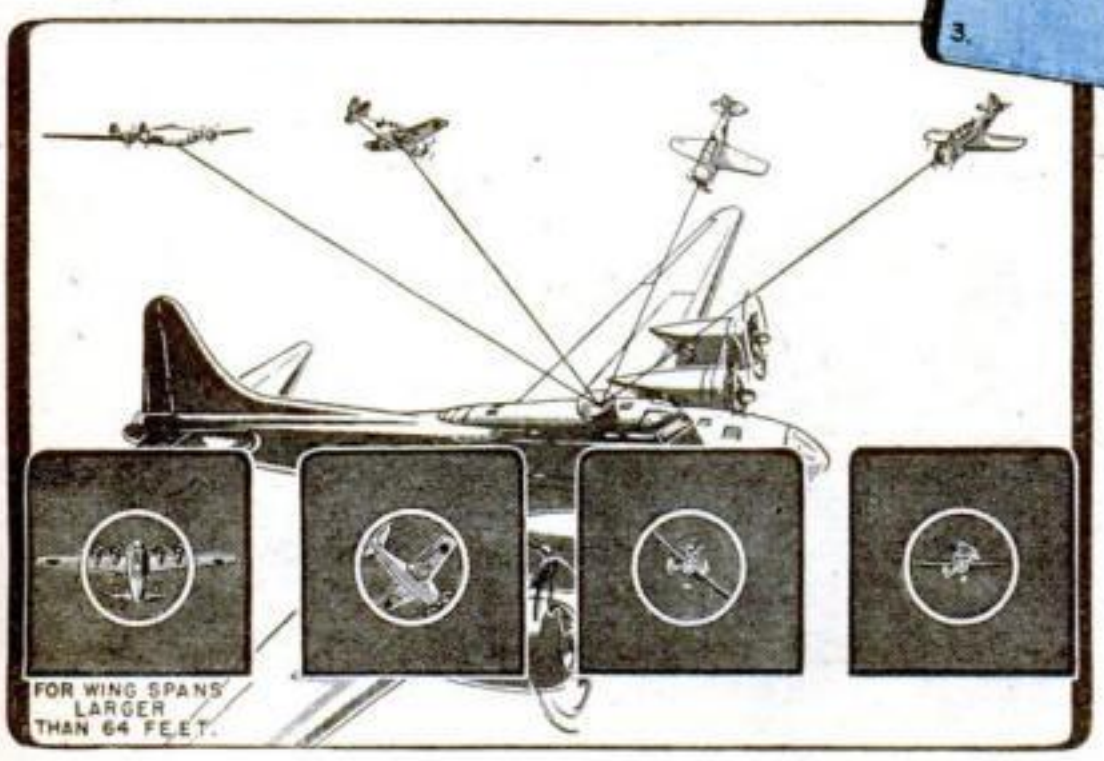
machine gun from 600 to above 1,000 yards.

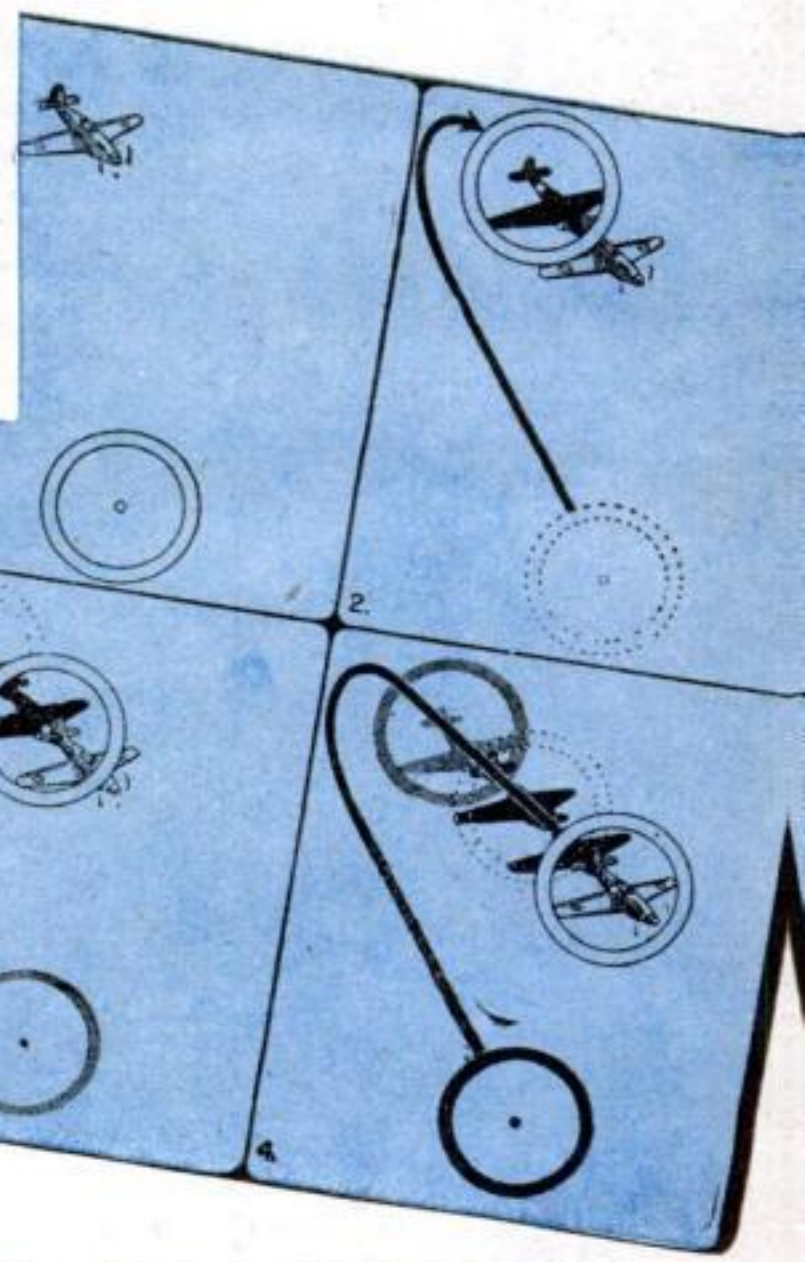
All the gunner needs to do is to keep a ring of light in the sight lined up with the target. The electronic device does the rest, instantaneously compensating for such factors as the speed and altitude of the plane; angle, range, and speed of the target, and velocity of the bullet. A pedal adjusts the circle's size.

After only five hours' instruction with the K-8, it is reported, a gunner can score from 50 to 90 percent as many hits in the air as he could when firing at a stationary target from a stationary platform.

Electronic Sight Makes Bomber Guns Deadly

A HOT reception is guaranteed enemy fighter planes attacking U. S. heavy bombers, thanks to the K-8 electronic gun sight. Invented by Erwin Hale and Irving Doyle, of the Fairchild Camera & Instrument Corp., New York, the new sight is said to extend the effective range of a .50 caliber





When target is sighted (1), gunner sets a dial for its wingspread and swings sight to move reticle image behind it (2). Working circle over the wing tips (3), he gets on target (4) and then just tracks and fires

The drawing at the left shows how enemy planes attacking from various angles are framed in the gun-sight circle. The sight automatically compensates for angle of attack in making computation for lead and range

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Marooned Airmen Picked Up by Planes Flying at 130 M.P.H.

NOW a stranded man can be snatched off the ground by an airplane in full flight. The equipment needed to pick him up without stopping has been perfected by Army Air Forces, and four men have experienced this new thrill.

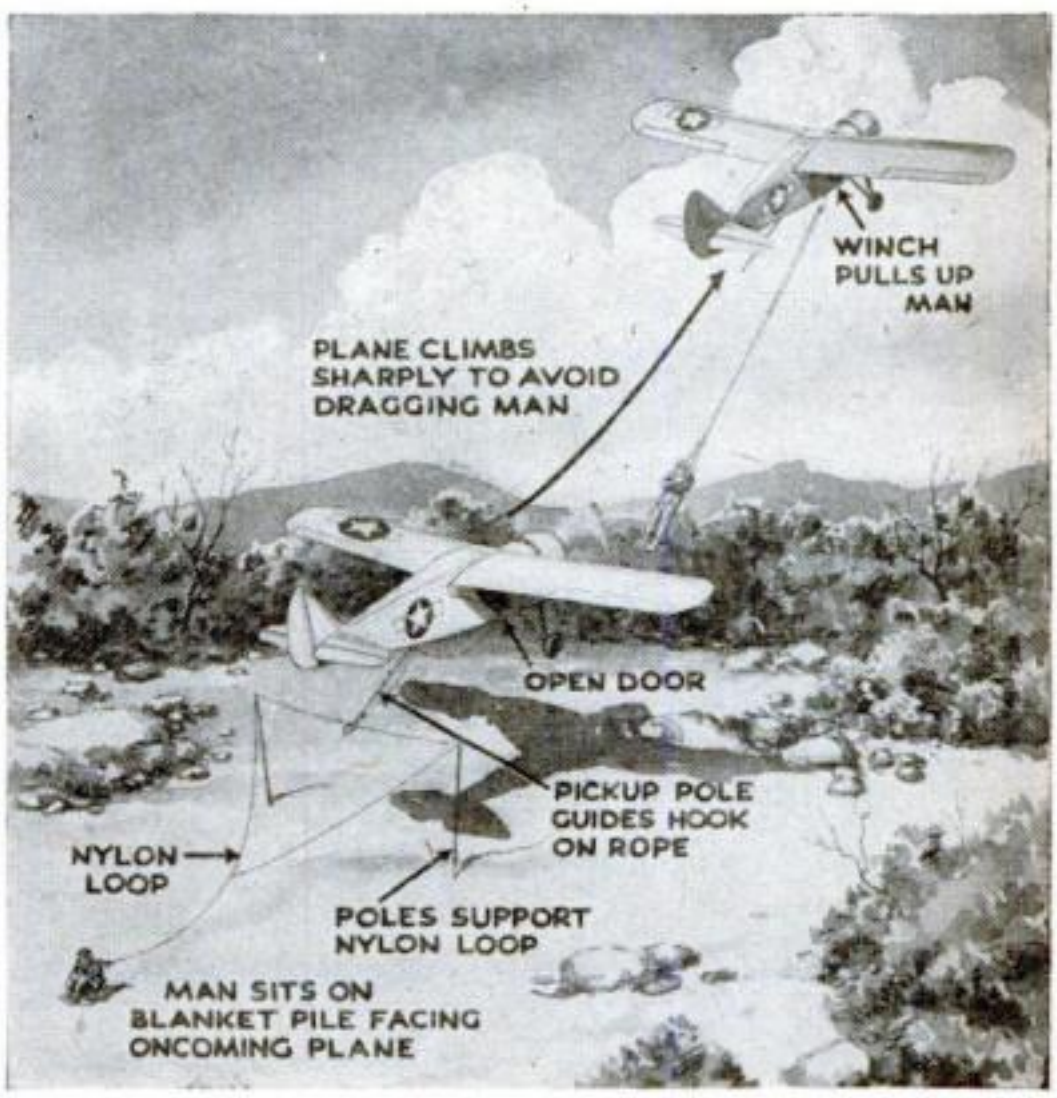
The apparatus is similar to that used to lift gliders off fields where planes cannot land. The nylon loop and harness needed by the man to be rescued can be parachuted to him, along with instructions for suspending the loop between two poles. The devices required in the plane—a tow rope, hook, guide pole, automatic delayed-action brakes and electric reeling motor—can be installed in less than two hours. When the hook catches the loop hung up by the man on the ground, his ascent begins. Two minutes and 45 seconds later, he is safely seated in the plane.

Tests with dummies and sheep were made first. Use of a chimpanzee was also suggested, but the pilot threatened to go overboard if a chimp came aboard his plane, so the idea was dropped. Lt. Alexis Doster, a paratrooper who later died of infantile paralysis, was the first man to hop a plane this way. "The only sensation," he reported, "is a smooth whir of air around you and then the ground disappears underneath. If I hadn't heard the wind, I wouldn't have known I was moving." Doctors found that neither Lieutenant Doster nor any of the other three human guinea pigs suffered ill effects from being yanked aloft like sacks of mail.

Human pickups are made now at 130 miles per hour indicated air speed. A man's body is so streamlined and flexible that it jolts the plane less than a bundle. At present only a light-weight, highly maneuverable plane is employed, but AAF experimenters hope eventually to whisk a man up with a fast fighter plane.



This harness gives the man about to be yanked aboard a moving plane less of a jolt than he would sustain if he jumped off a chair stiff-legged. One soldier even tried to light a cigarette on his way up, but he failed because of a strong wind



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THIS IS HOW A HEAVY BLAST WILL AFFECT HOUSES



IN OPEN AREAS, blast force is largely dispersed. Only houses near by or in direct line with the explosion site are made unfit for habitation

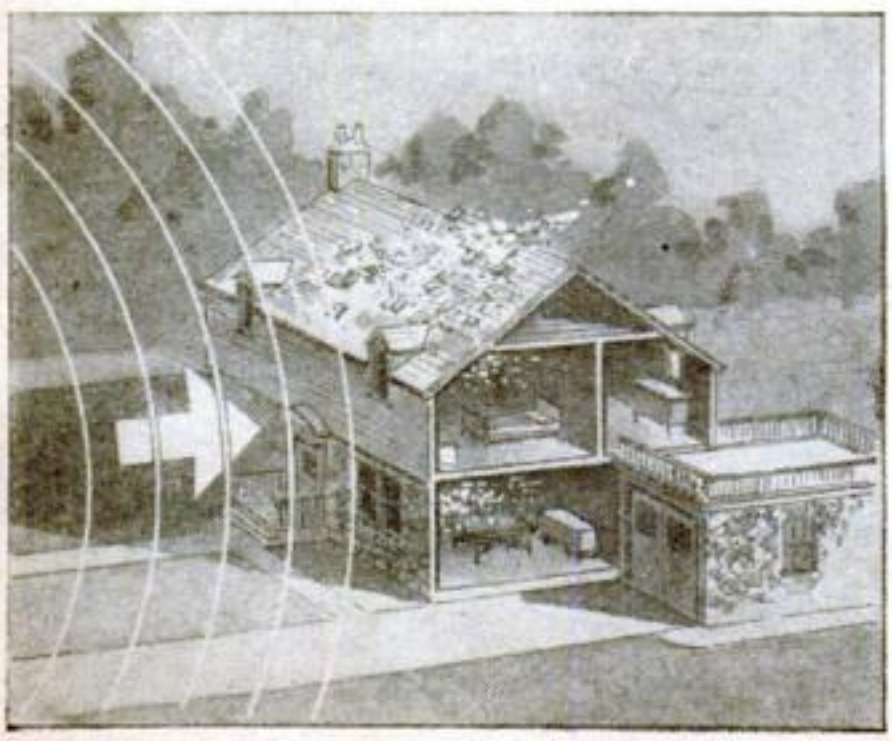


IN CONGESTED AREAS, destructive force is more concentrated. Structures surrounding a blast site are demolished; others comparatively unharmed

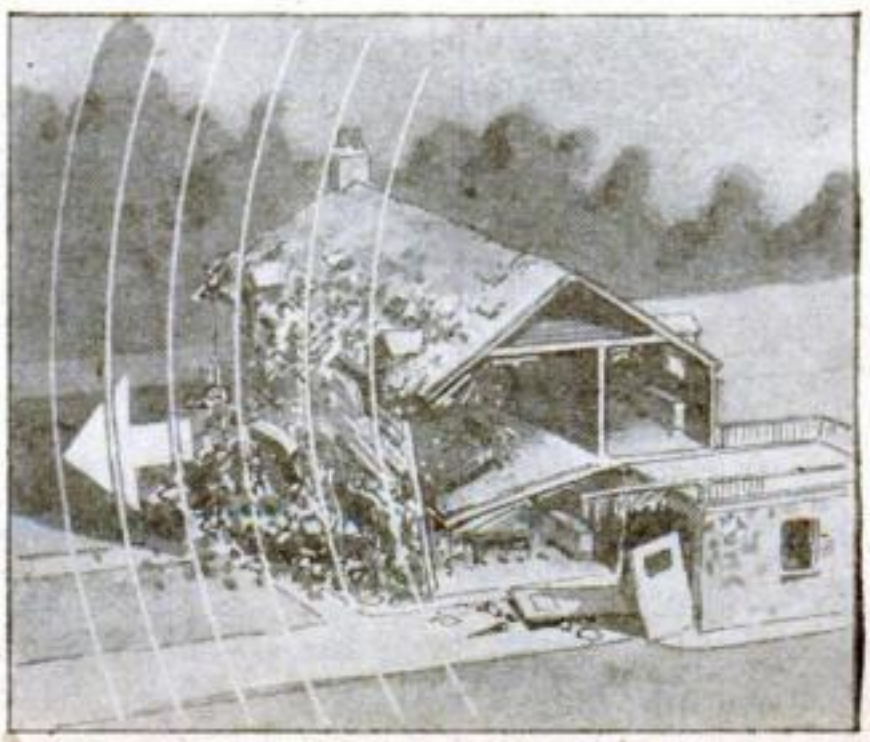
What Is *BLAST?*

BRITAIN'S ORDEAL BY ROBOMB AND ROCKET DISCLOSES NEW FACTS ABOUT THE STRANGE PRANKS PLAYED BY POWERFUL EXPLOSIONS

PRESSURE WAVE caused by air and expanding gas rushing outward from the explosion gives houses a short, fierce blow, causing most serious damage



SUCTION WAVE produced by air rushing back to fill the partial vacuum does the greater amount of harm. Houses aren't built to stand outward pull



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FREAKS OF BLAST. Bouncing from side to side of a street like balls on a billiard table, shock waves may shatter an occasional window far from the crater with no apparent reason. Blast can even turn a corner to do damage on an intersecting street, as illustrated in the upper left corner of the drawing

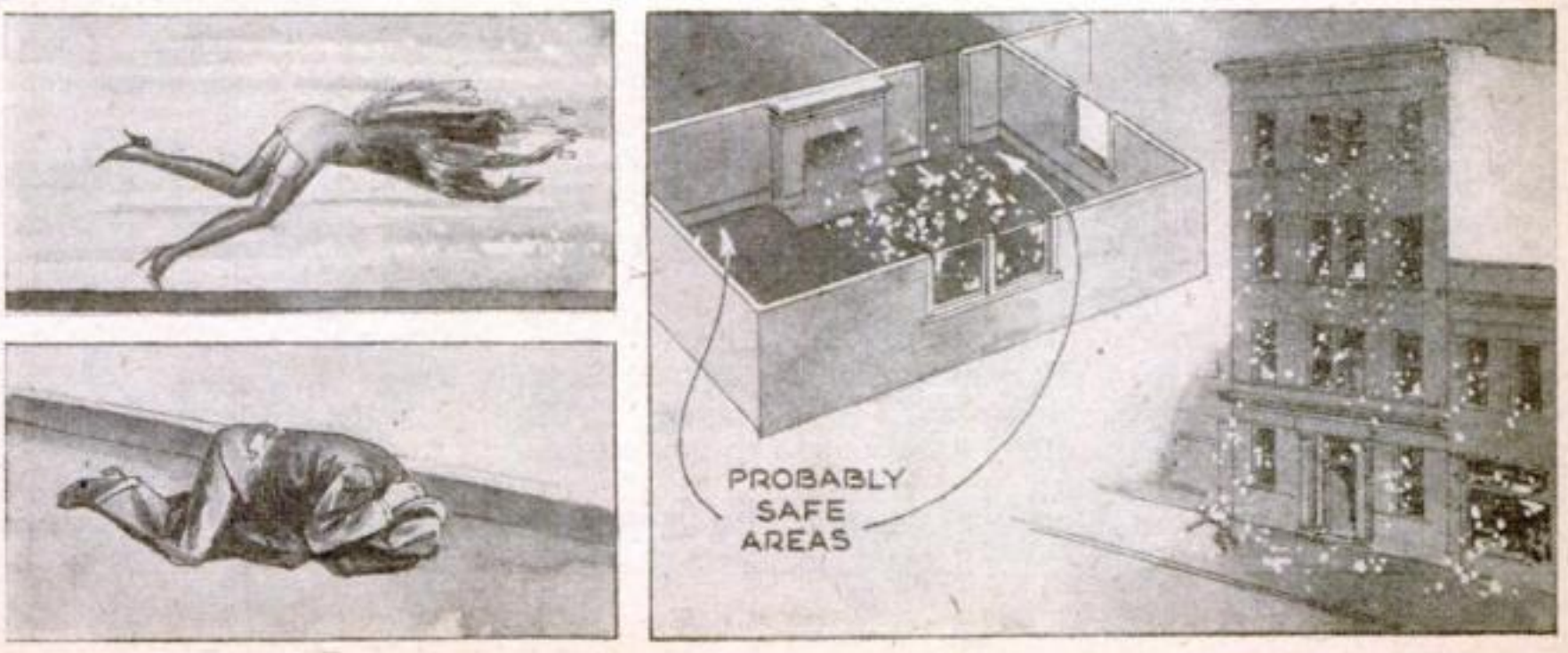
Drawings by B. G. SEIELSTAD

GERMAN robombs pelting London demolished a house without cracking the eggs in a dish in the cupboard, blew the clothes off a woman without ruffling those of a man beside her, and killed many persons without inflicting visible injuries. One victim, in fact, was found still standing in a pub with a drink in his hand, but dead.

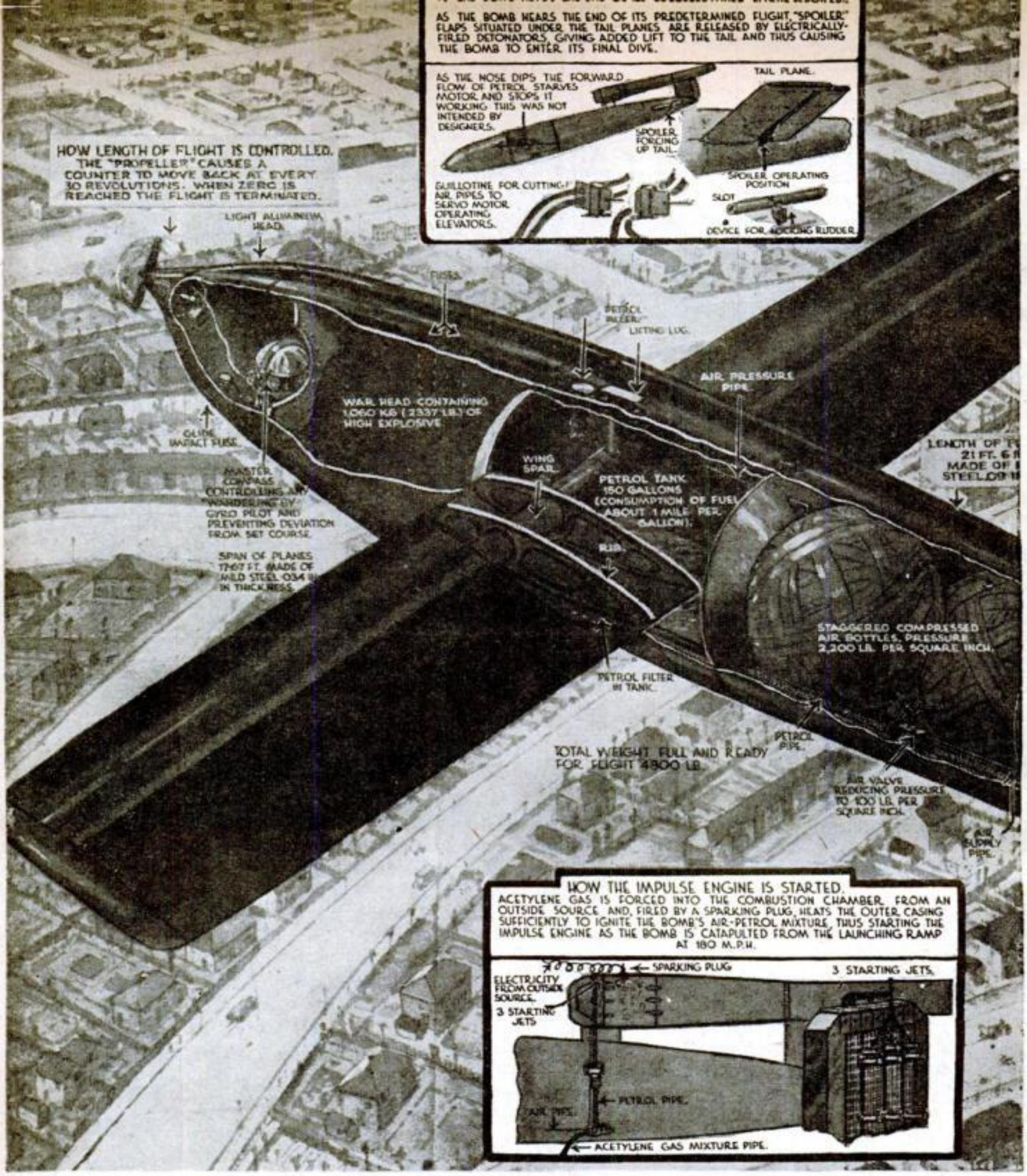
These cruel tricks were played by blast. It is a phenomenon of explosions that occurs so swiftly that it is uncanny. But its eerie effects can be explained. Scientists who have studied blast point out that it can be both seen and photographed.

Blast is one of three ways in which an exploding bomb or shell causes destruction. The other ways are (1) by fragmentation, or hurling out parts of itself, and (2) by tossing around chunks of other solid material such as paving blocks. The casing around the explosive in the V-1 and V-2 bombs was too light to cause much damage by fragmentation. The V-1 bombs did not penetrate deeply enough when they landed

SAFETY HINTS. A woman may have her clothes torn off by blast. Britishers were advised to lie on one side in the gutter, with knees drawn up and hands covering ears and back of neck. In a house, safest spots are inside corners away from openings. On the street, look out for glass sucked out of windows



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SECRETS OF THE V-1 FLYING BOMB. This drawing by G. H. Davis for the Illustrated London News shows what the British have learned about the robomb from careful examination of specimens shot down or found unexploded. V-1 is, in effect, a small, automatically controlled, jet-propelled airplane carrying a ton of high explosive in its nose. Designed for quantity production, it is made almost entirely of

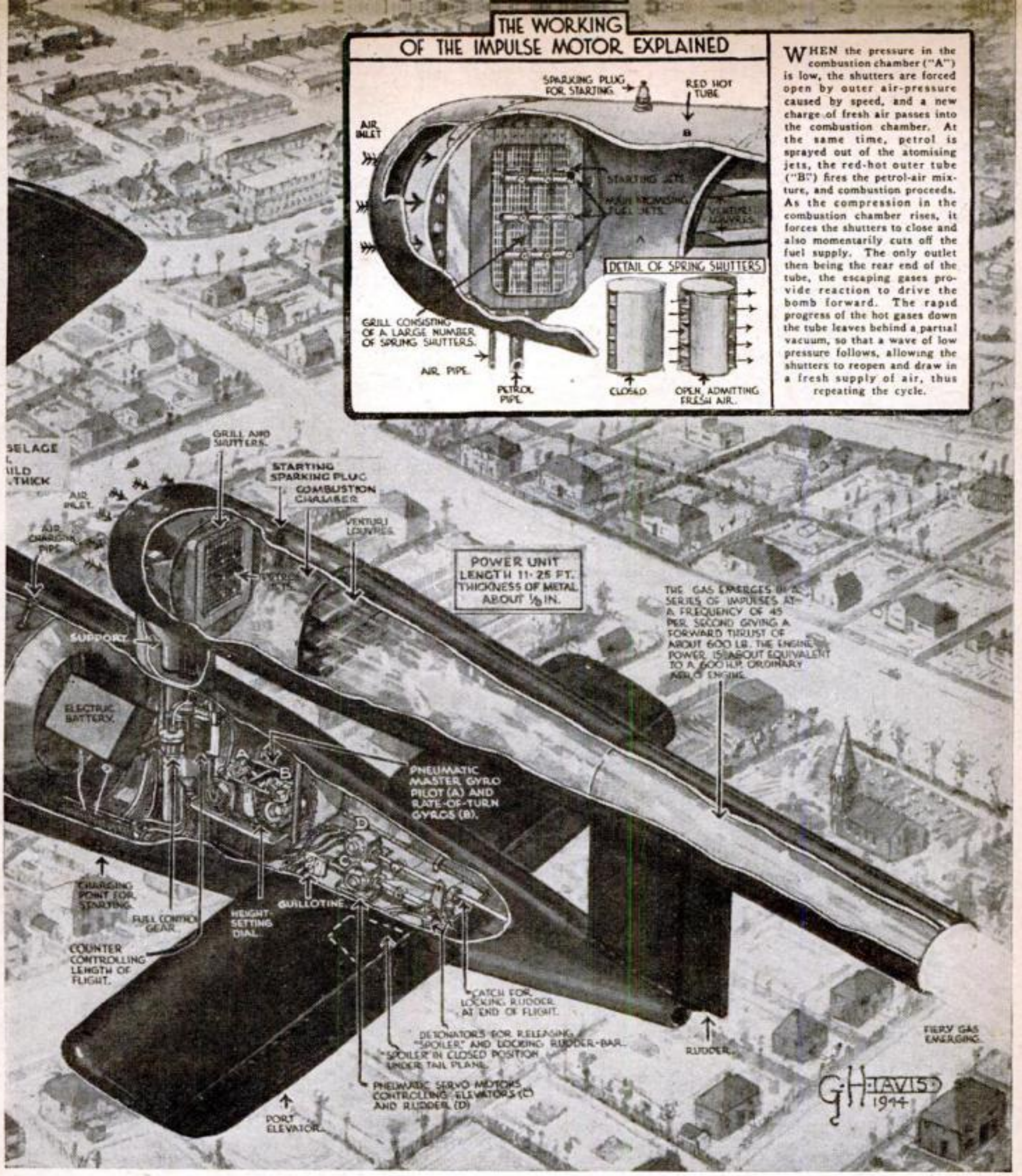
to dislodge great amounts of other solid materials. But the blast effects from their war heads was terrific.

The war heads of the V-2 bombs were similar, but these bombs penetrated more deeply than the V-1's. The result, Prime Minister Churchill has revealed, was "somewhat heavy damage in the immediate vicinity above the crater, with rather less extensive blast effect around it."

Blast effect consists of a sudden wave of pressure, quickly followed by a suction wave. The pressure wave is caused by the quick liberation and expansion of immense quantities of hot gases. The suction wave results largely from the cooling of these gases as they encounter resistance and lose momentum.

The detonation of a high explosive creates such intense heat that the temperature of

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mild steel. Its pilot is a freely pivoted gyroscope driven by compressed air from spherical bottles. This is preset for direction and height of travel and corrects any deviation from course by operating the rudder and elevators through two servo motors. Distance is controlled by the "propeller" in the nose. When this has ticked off a predetermined number of revolutions, spoilers turn the bomb's nose downward

the gases freed is raised several thousand degrees. These gases burst out in all directions, much faster than sound travels. Part of their momentum is transmitted to the air, water, earth, or whatever else may surround them. Thus the expanding gases create an ultra-fierce hurricane which demolishes everything in its path until its force is spent.

The stampede of gases and air leaves a partial vacuum where the explosion occurred. Air rushes in to fill it, causing a slower but more prolonged wave of pressure toward rather than away from the site of the explosion.

According to an expert on the staff of the Research and Experiments Department of the British Ministry of Home Security, the initial outward pressure from the explosion of a V-1 robomb caused the *most serious*

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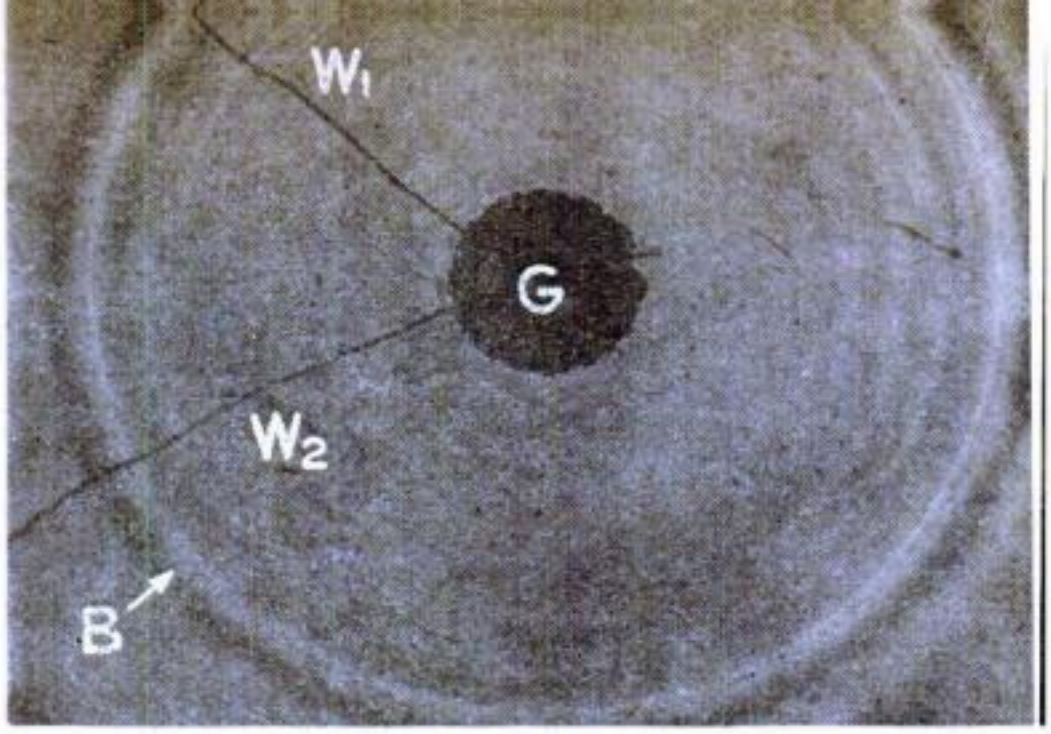
damage, but a *greater amount* of damage resulted from the secondary inward pressure. This happened because the first blow was fierce but short, while the second one was less intense but lasted longer and could be felt at a greater distance.

The sudden contact of expanding hot gases with the atmosphere or other obstacles around them causes a shock wave which has the same characteristics as a sound wave—pressure, velocity, amplitude, and frequency. This shock wave moves through air, water, or earth like sound.

Both the air blast and the shock wave start out virtually simultaneously with fragments of the casing or other solid pieces around the explosive. It takes the heavier, solid materials longer to gain speed, so the flying debris lags behind the blast effect at first. But, once having gained momentum, the solid pieces hurtling through the air are harder to slow down and stop, so they may overtake the hurricane and shock wave.

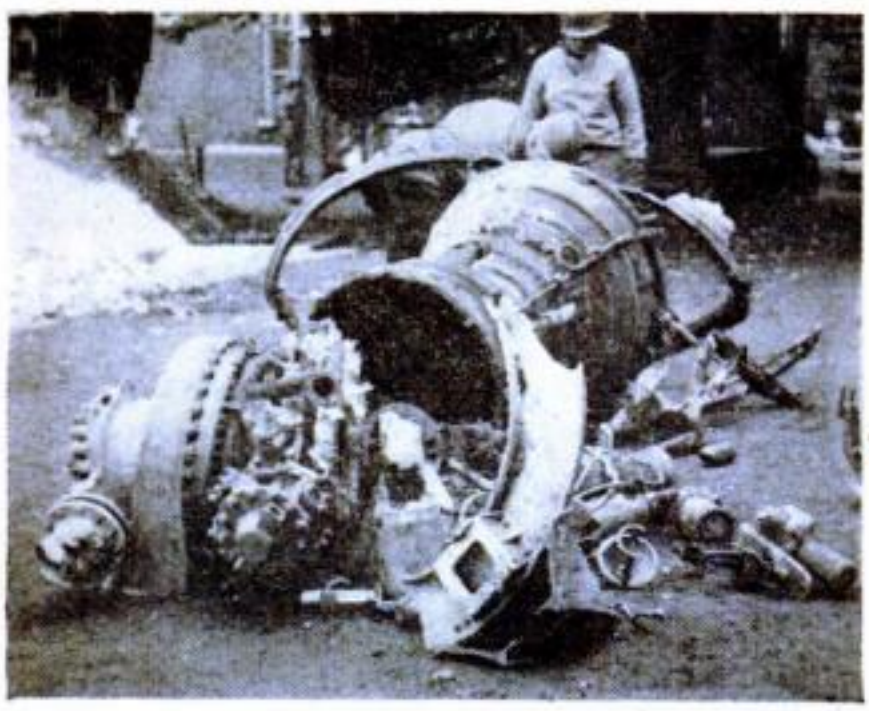
The turbulence of this extremely swift rush of forces accounts for many of the freakish effects. The changes in pressure may be so great and so rapid around a person as to kill him without leaving an external mark. A woman's clothing, but not a man's, may be torn off because there is more air space under a woman's garments than under a man's. Blast, like a gust of wind, can also be deflected by sturdy obstacles.

The British were successful in intercepting a high percentage of the V-1 bombs, but the V-2's traveled so much higher and faster that they seemingly struck like lightning, and the explosion of the first of these retaliation weapons was mistaken for the bursting of a gas main.—VOLTA TORREY.



PORTRAIT OF BLAST. In this remarkable test photo, the dark band (B) is the front of a shock wave spreading from an explosion (G) produced by setting off a detonator supported by wires (W_1, W_2). Exposure was made 1/10,000 second after explosion

THIS IS V-2. Two Yanks examine the wreckage of a rocket bomb that fell in Belgium. In the foreground is the propelling unit. V-2 normally buries itself deeply, explodes with terrific force



You Can See Blast

By PROF. A. M. LOW

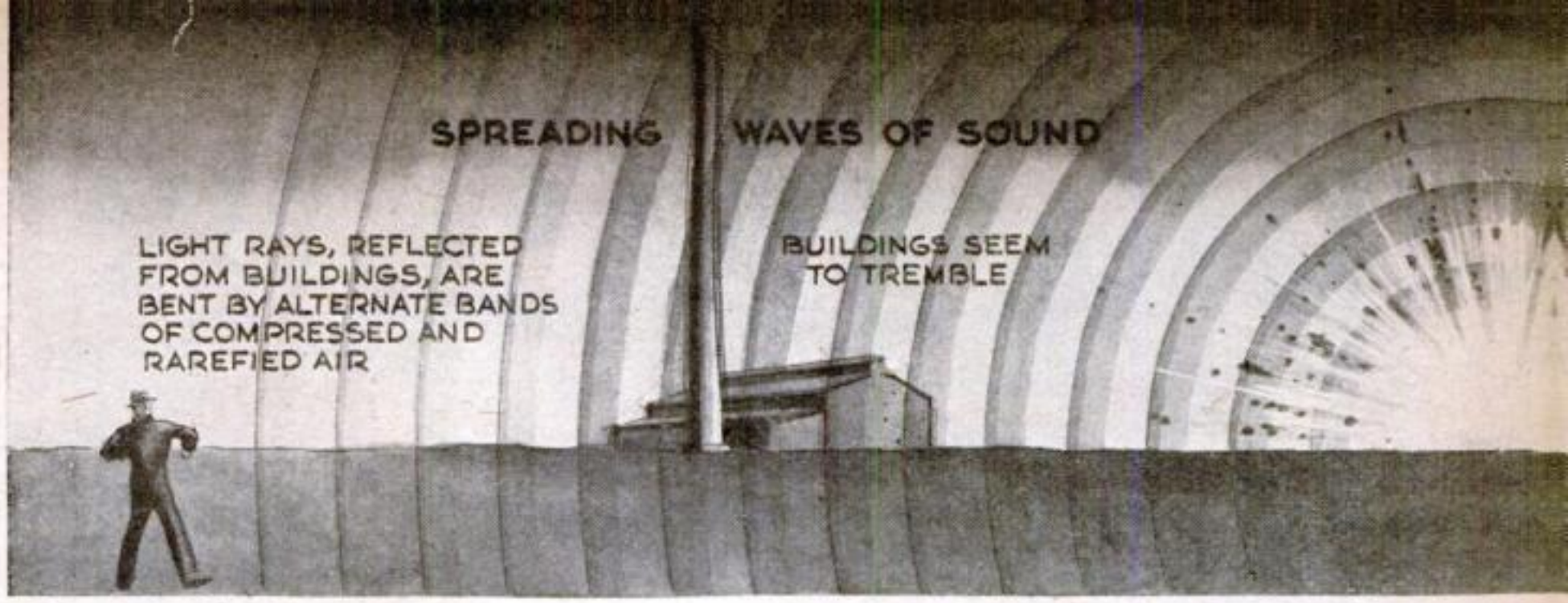
Radio-controlled-plane inventor and president of British Institute of Engineering Technology

TO SEE blast, appears at first to savor of spiritualism. In fact, it is a very simple phenomenon and illustrates a principle which has been used for many years by some architects to discover the acoustics of a building before it is erected.

Like other forms of noise or sound, blast is usually propagated by alternate waves of compression and rarefaction in the air. The noise wave may, of course, have a front of such pressure that it can disintegrate a wall; at greater distances, it may do no more than produce a gentle oscillation of the eardrum. The wave of rarefaction which follows plays strange tricks—draws walls outward, opens doors, and gives a building the peculiar "rocking effect" with which Londoners have become familiar.

Once the existence of a high-pressure wave front is appreciated, the seeing of blast is easy to understand. A comparable observation is very familiar. We have all noticed that a stick in water appears bent when looked at from an angle. Everyone has also seen the apparent trembling of an object when viewed through a column of hot air—over a chimney, for example. To see

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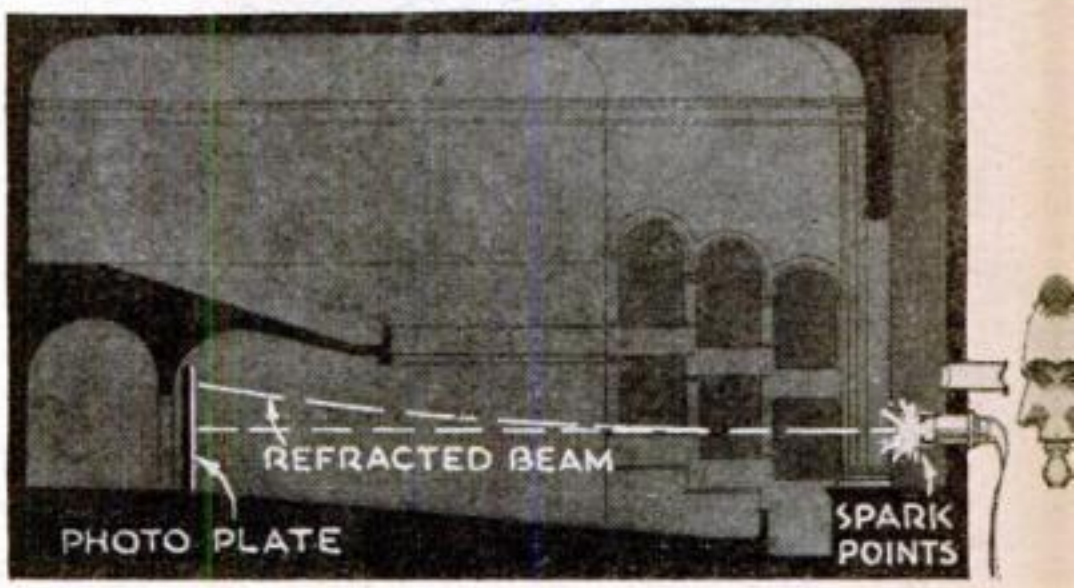
SEEING BLAST. Buildings and even clouds seem to tremble in air agitated by an explosion. Light passing through alternating bands of compressed and rarefied air are refracted, or bent. "Heat waves" are a similar phenomenon

blast is almost exactly the same; it is merely a demonstration of the bending, or refraction, of light, when the beam passes from one medium into another which has a different density.

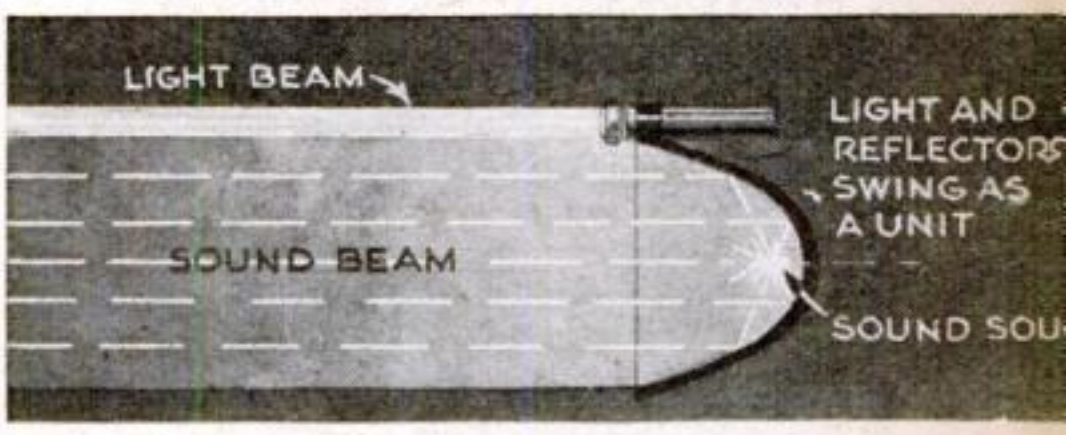
An observer looking at objects by light that is passing through air under compression at intervals from an explosion may see blast. The light is bent as it passes from normal to compressed air and again as it leaves the denser area for the ordinary atmosphere during the incidence of the wave. The eye, therefore, sees the background of clouds or buildings as if these were trembling.

Most atmospheric sound effects are influenced by weather conditions. In wet weather, blast may travel faster than in dry, although it always exceeds the velocity of sound for the first part of its travel. The arc of blast is quite often defined by condensation of moisture due to pressure. A comparable effect is occasionally seen in the trail left by high-flying aircraft. If there is sunshine and if the light is in the right direction, a rainbow effect is not impossible, because of the refraction by each particle of liquid suspended in the air.

In the laboratory, the conditions are not hard to reproduce on a small scale. Usually, a recurrent spark is employed, and a system of lenses and mirrors so arranged that the light of one spark is bent by the noise wave *(Continued on page 230)*

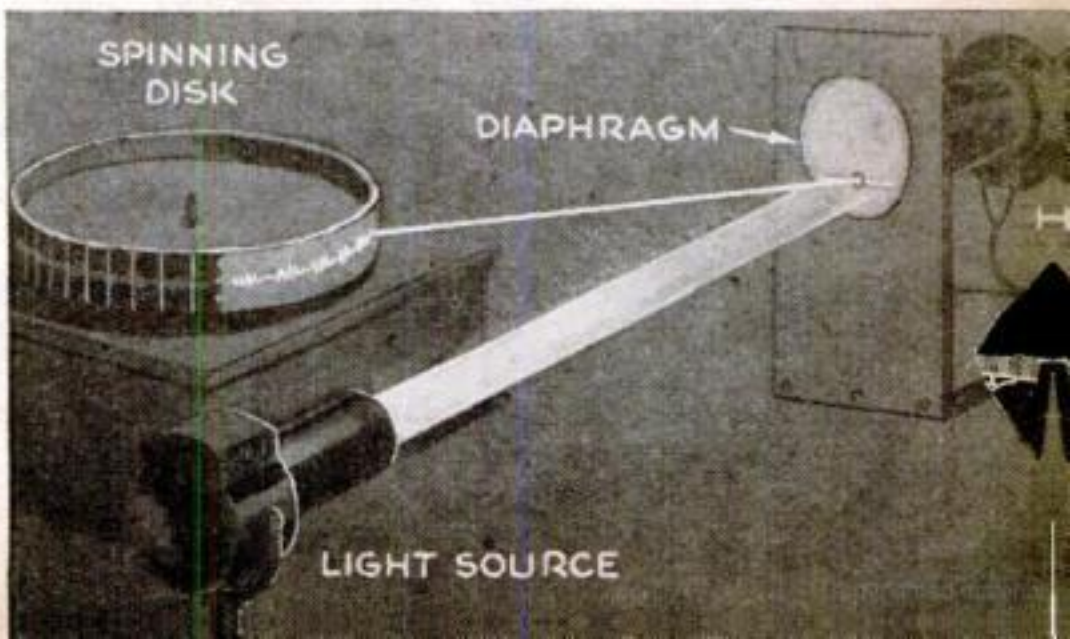


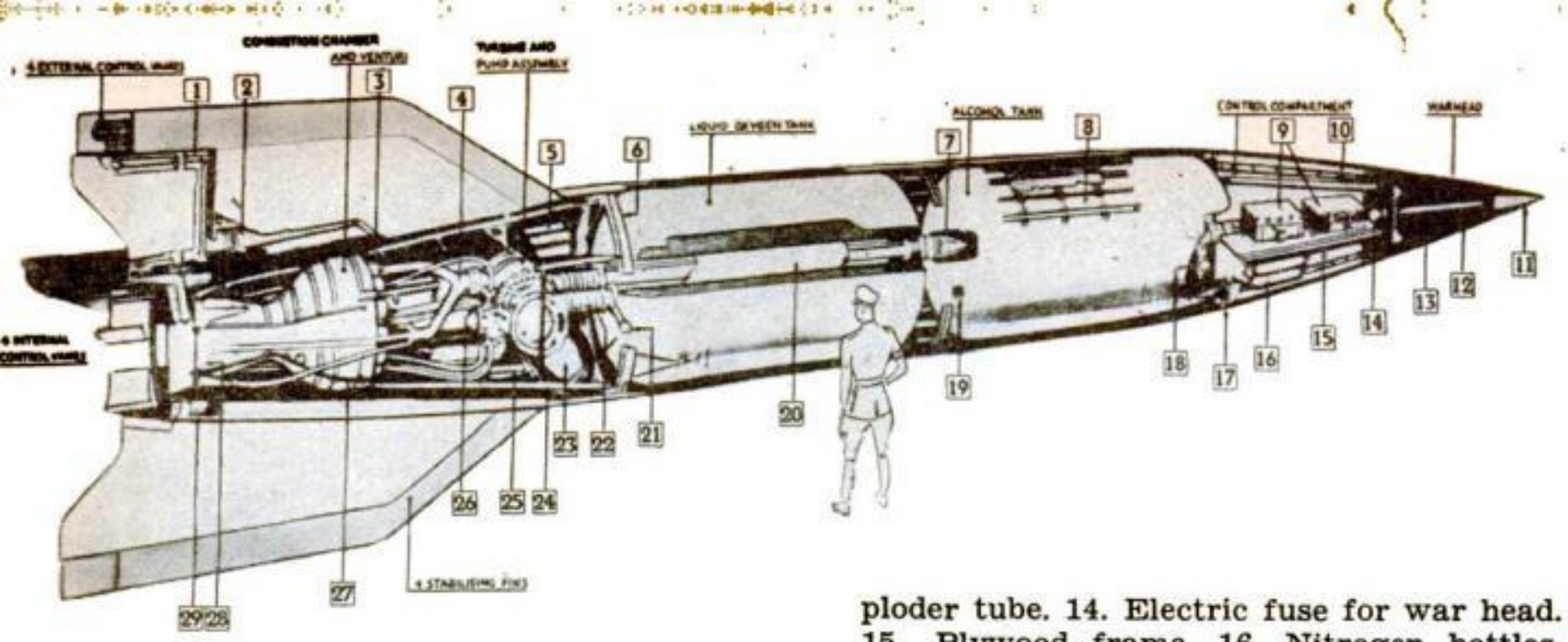
SEEING SOUND. Architects test acoustical qualities of proposed theater designs by using this setup with a plaster model. Light from a spark is bent by the waves of reflected sound from a preceding spark, and the resulting displacement is recorded on the photographic plate



SPOTTING AN ECHO. The source of an unwanted echo is found by "firing" noise in various directions from a sound reflector. When the echo is heard, the offending spot is located by a beam of light parallel to sound beam

SOUND LEAVES ITS AUTOGRAPH. With the audiometer, or sensitive optical kymograph, sound is translated into visible form as a wavy line on light-sensitive paper or film. The sketch shows a simple form of the instrument





SECRETS OF V-2 are revealed in this official diagram prepared by the British Air Ministry on the basis of latest available information. Numbers indicate: 1. Chain drive to external control vanes. 2. Electric motor. 3. Burner cups. 4. Alcohol supply from pump. 5. Air bottles. 6. Rear joint ring and strong point for transport. 7. Servo-operated alcohol outlet valve. 8. Rocket-shell construction. 9. Radio equipment. 10. Pipe leading from alcohol tank to war head. 11. Nose. 12. Conduit carrying wires to nose of war head. 13. Central exploder tube. 14. Electric fuse for war head. 15. Plywood frame. 16. Nitrogen bottles. 17. Front joint ring. 18. Pitch and azimuth gyros. 19. Alcohol filling point. 20. Alcohol delivery pipe to pump. 21. Oxygen filling point. 22. Concertina connections. 23. Hydrogen peroxide tank. 24. Tubular frame for turbine and pump assembly. 25. Permanganate tank. 26. Oxygen distributor from pump. 27. Alcohol pipes for subsidiary cooling. 28. Alcohol inlet to double wall. 29. Electro-hydraulic servo motors. Arranged around the tail are four stabilizing fins with external control vanes at their tips and internal control vanes behind the tail aperture.

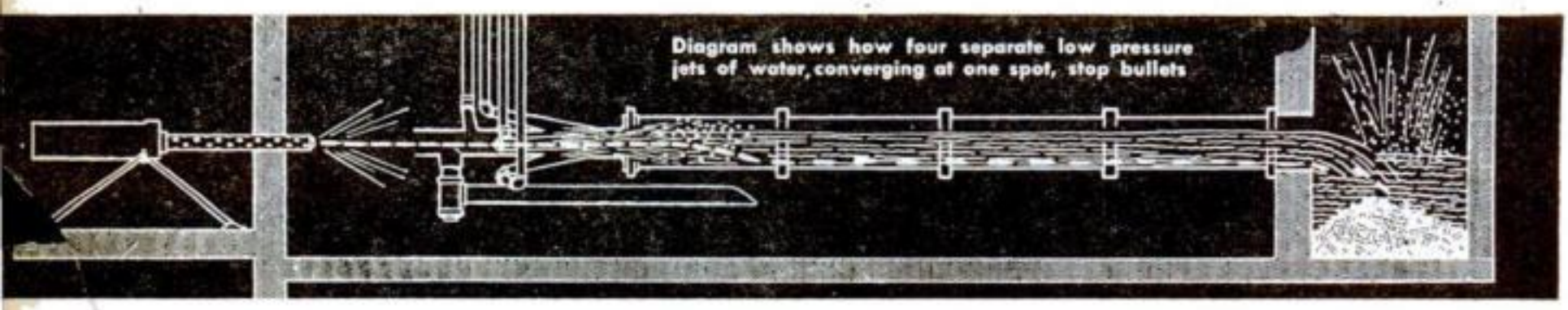
Water Pressure Stops Bullets in Factory Testing of Machine Guns



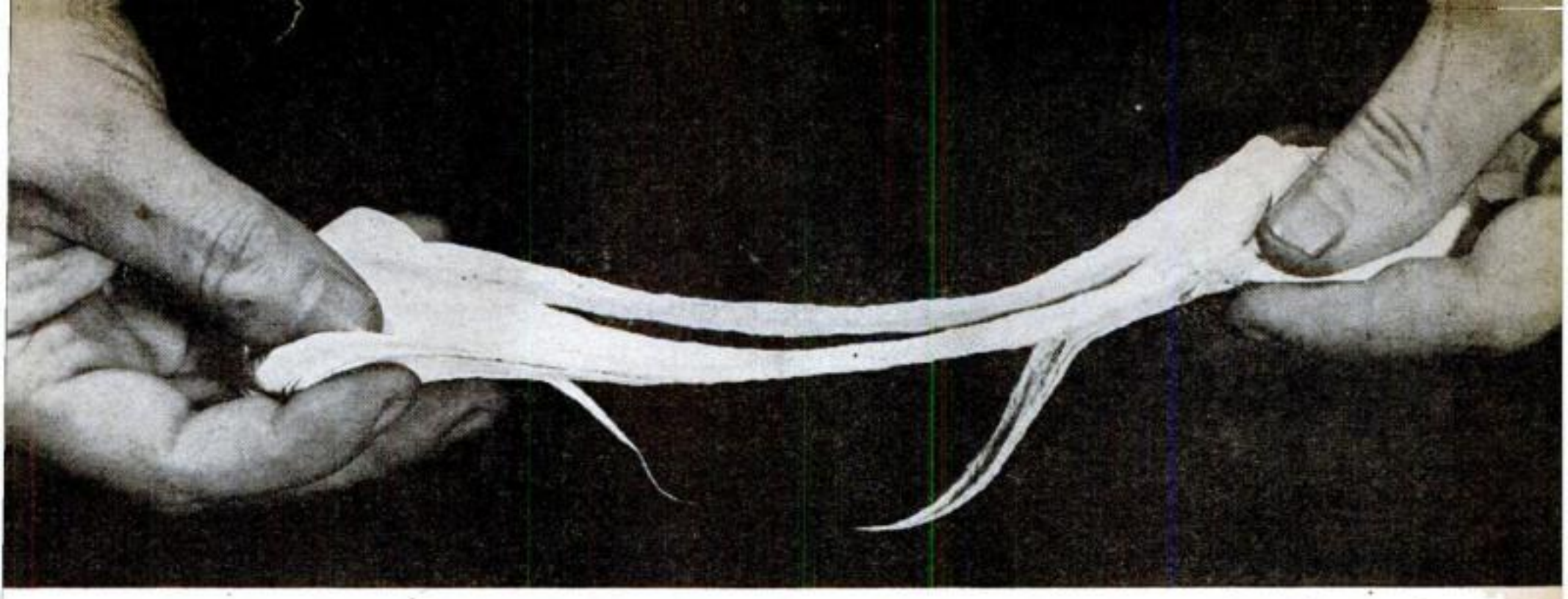
Machine guns are tested by being fired through ports into hydraulic barrier as illustrated by the diagram below

A NEW hydraulic bullet trap has been developed by the General Motors Corp., Syracuse, N. Y., for use in the test-firing of machine guns. The bullets are fired into a tube, near the mouth of which four converging jets of water impede their velocity so that their force is practically spent when they drop out into a water cushion at the farther end for subsequent salvage.

Safety devices include exhaust ventilation that carries away powder fumes as the guns are being fired, and a system of controlling door locks that makes it impossible for anyone to be near the muzzles of the guns during test firing. Irving Gilson, inventor of the bullet trap, is foreman in the maintenance department at the Brown-Lipe-Chapin division of General Motors.



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STRETCH IT, and it pulls like taffy. This curious substance is a by-product of research in silicone rubber, a heat-resisting synthetic used in sealing searchlight lenses and making gaskets for superchargers

Here Is Putty with a Bounce

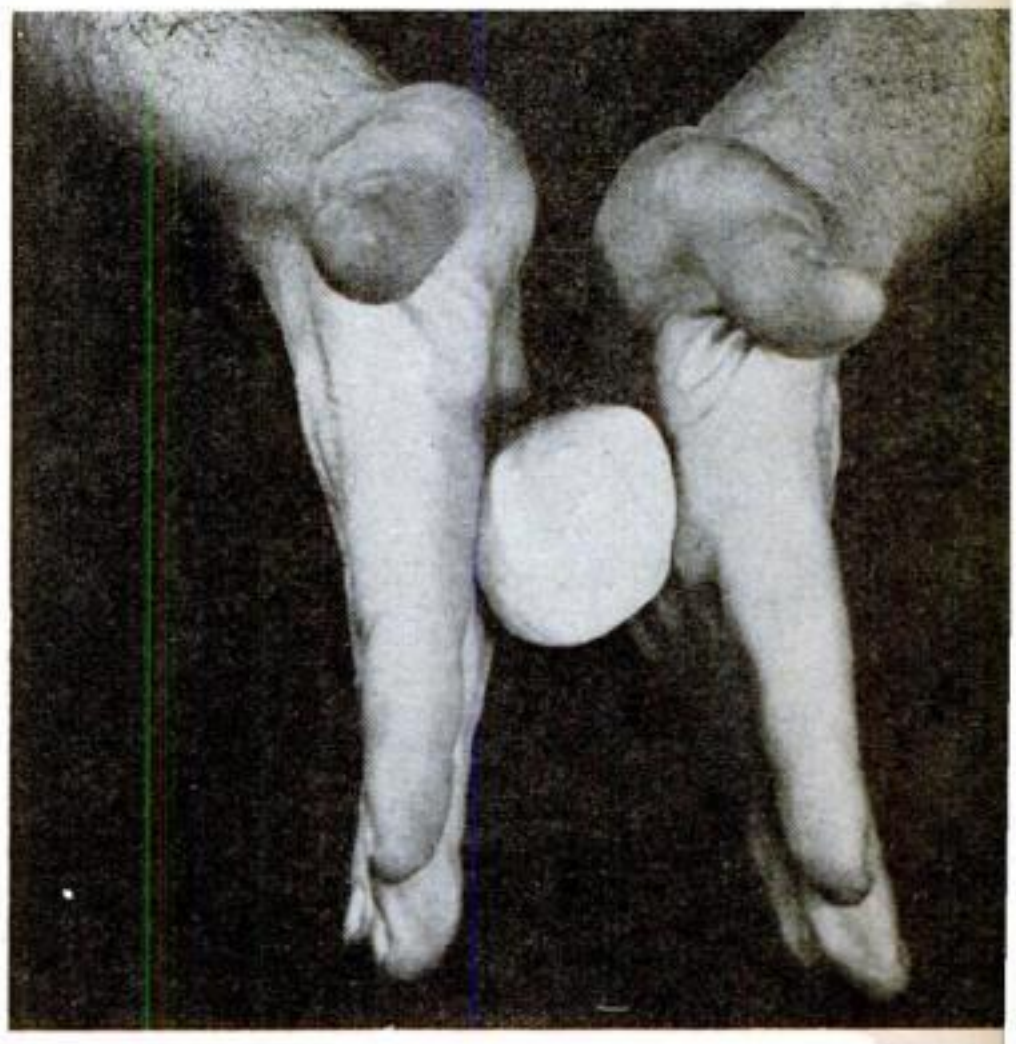
Research in silicone rubber yields a strange by-product that may have its own uses.

EXCEPTIONAL resistance to heat characterizes silicone rubber, an entirely new synthetic product developed by General Electric research engineers. Rings of the material now replace asbestos to cushion the glass of naval searchlights and blinker signal lamps against the terrific shock of gunfire, materially reducing breakage. Gaskets of the same composition serve in superchargers for the B-29 Superfortresses that bomb Japan. These two war uses currently consume the entire output, but future household and industrial applications may include tires that will outlast a car, garden hose that can be left outdoors in heat or cold without damage, rubber gloves, and mountings for radio tubes.

Known for 50 years, chemicals called silicones have only recently been put to work. Hybrids between organic and inorganic substances, their ingredients are similar to sand and natural gas. A molecule of ordinary rubber has a "backbone" of carbon atoms, but a molecule of silicone rubber contains a more nearly indestructible spine of silicon and oxygen.

Besides silicone rubber, newly useful members of this chemical family include silicone oil, for hydraulic systems such as car brakes; and silicon plastics. A use remains to be found for the most curious silicone product discovered, which has been nicknamed "bouncing putty." The white substance can be pulled like taffy—but roll it into a sphere, and it bounces like rubber.

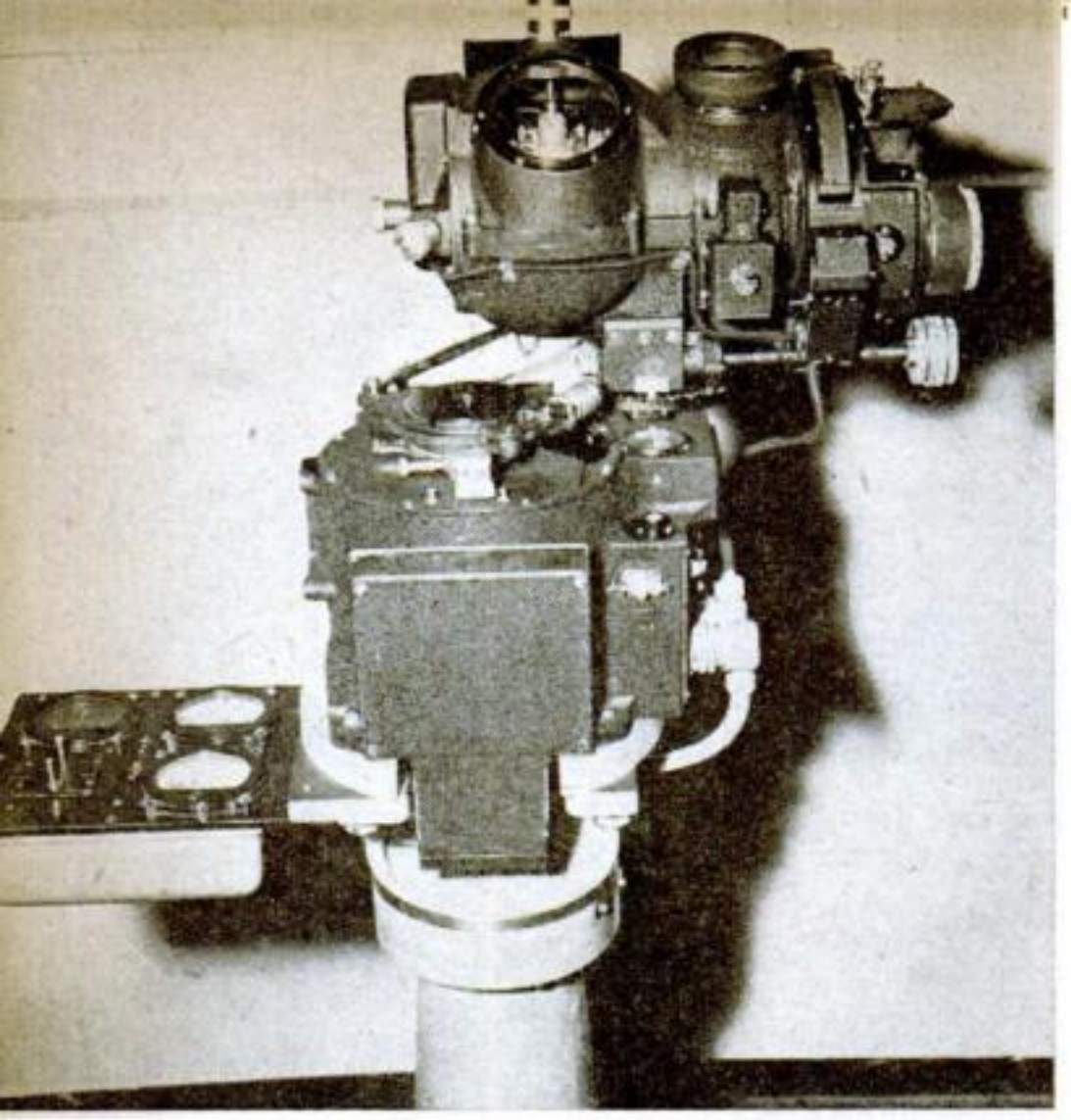
JANUARY, 1945



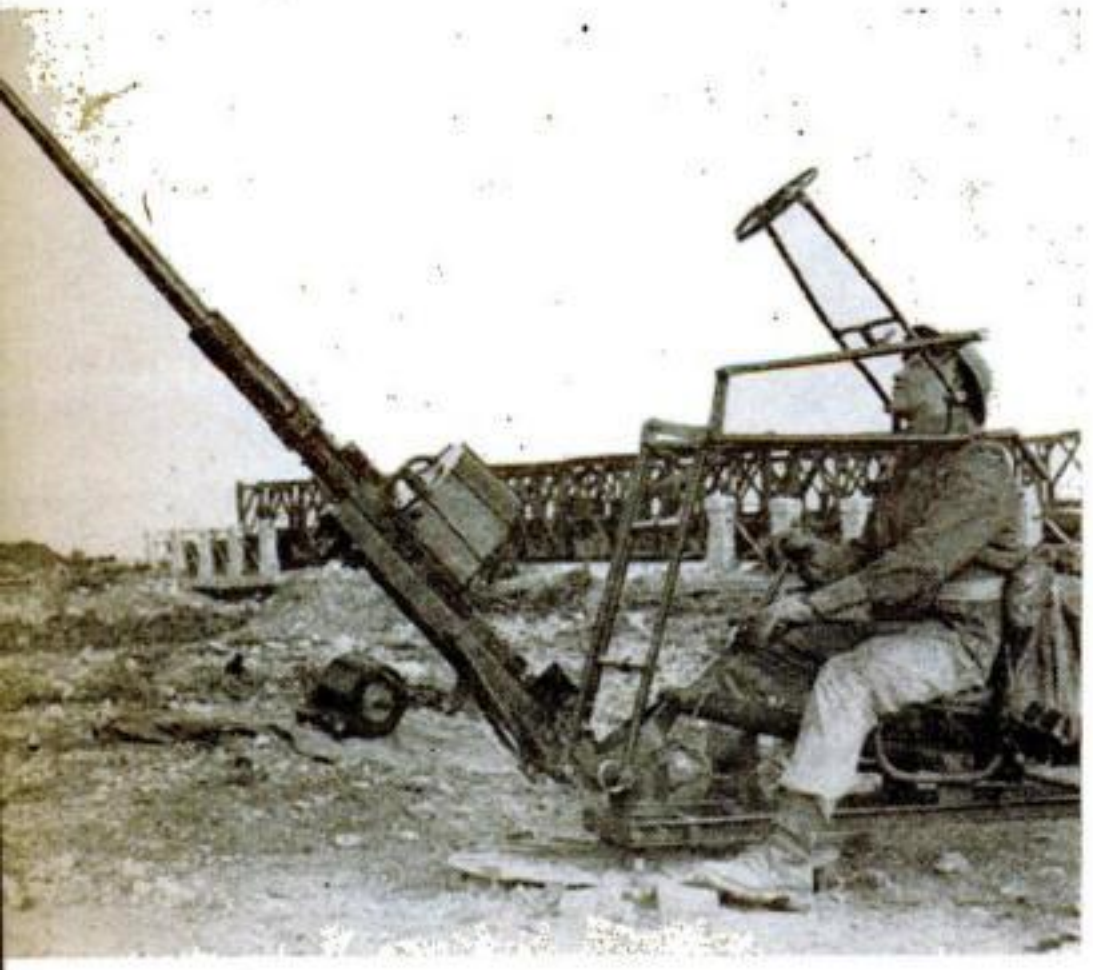
ROLL IT, and it handles like putty. Silicones represent a cross between organic and inorganic substances

IT BOUNCES! Thrown on a floor or table, it rebounds like a rubber ball. No use has yet been found for it





THIS IS THE NORDEN BOMBSIGHT, in the first photograph to be released by the War Department. Since it was invented by C. L. Norden in 1924, it has undergone continuous improvement and is now used by the Army and Navy with "pickle-barrel precision." To master its intricacies, a bombardier spends 482 hours over a period of 18 weeks. Basically, the sight consists of a telescope with special control mechanism, a gyroscope, an automatic pilot that controls the plane during the final bombing run on the target, and an electric release button. An article illustrated with drawings by Stewart Rouse, in P.S.M. for December 1943, page 116, explained the principles of the bombsight and its operation. Recently it was announced that inventor Norden had presented his patent rights to the U. S. Government for the nominal consideration of one dollar.



OERLIKON GOES ASHORE. After a long and successful career of knocking enemy planes out of the sky above U.S. and British ships, the Oerlikon 20-mm. antiaircraft cannon has got its land legs in this version used by British airborne troops. The gunner sits in a metal carriage that revolves on a circular base plate, counterbalancing the uptilted barrel. The sight, supported by a framework above his head, follows the elevation of the gun.

FOR MERITORIOUS SERVICE

SERVICE units of not less than 40 officers and men whose members have maintained the highest standards of service and conduct for at least 60 days will receive a mahogany Meritorious Service Unit Plaque from the War Department. Members of such units are entitled to wear the insigne shown below. It is worn centered four inches above the end of the right sleeve.

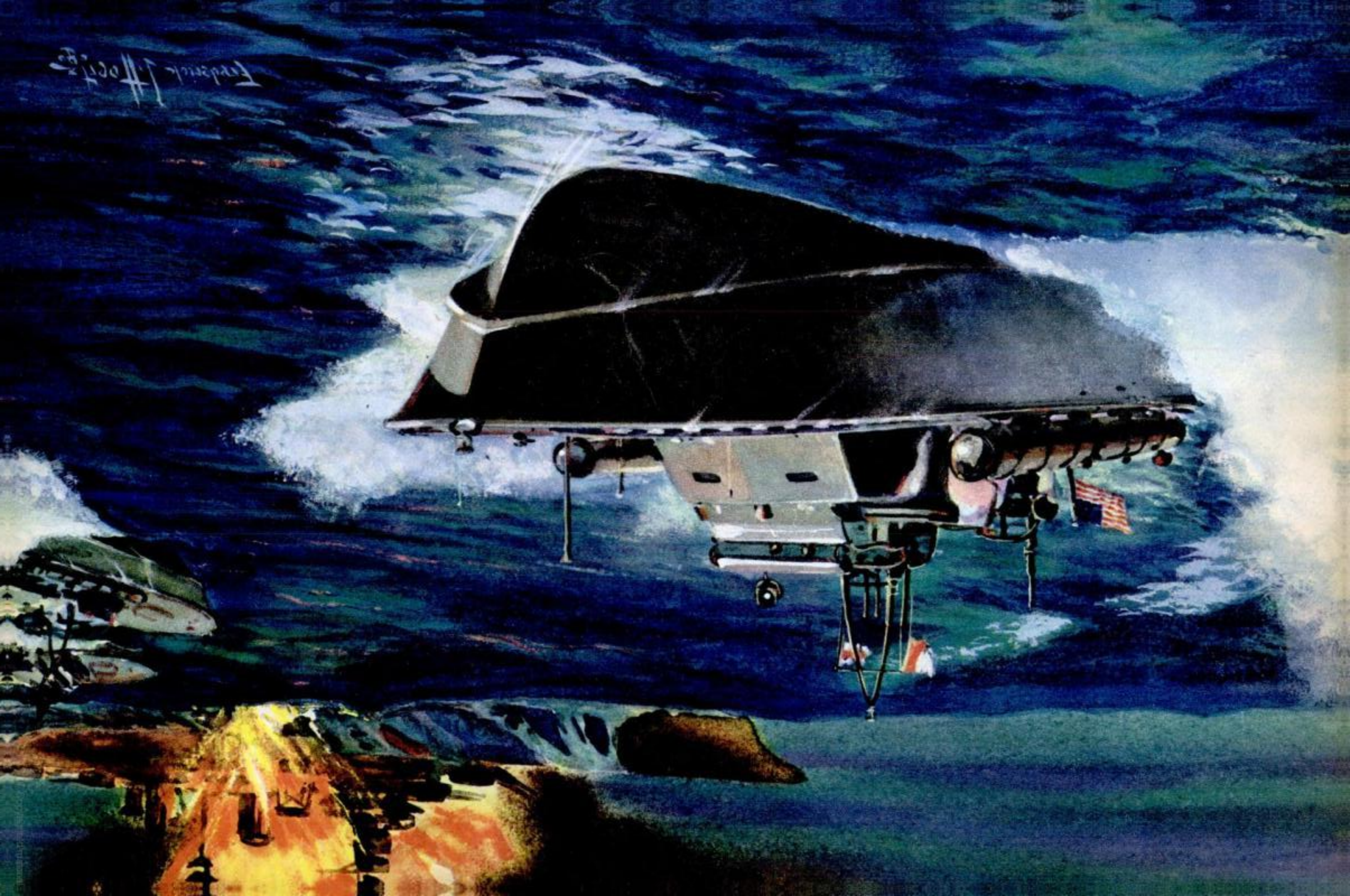


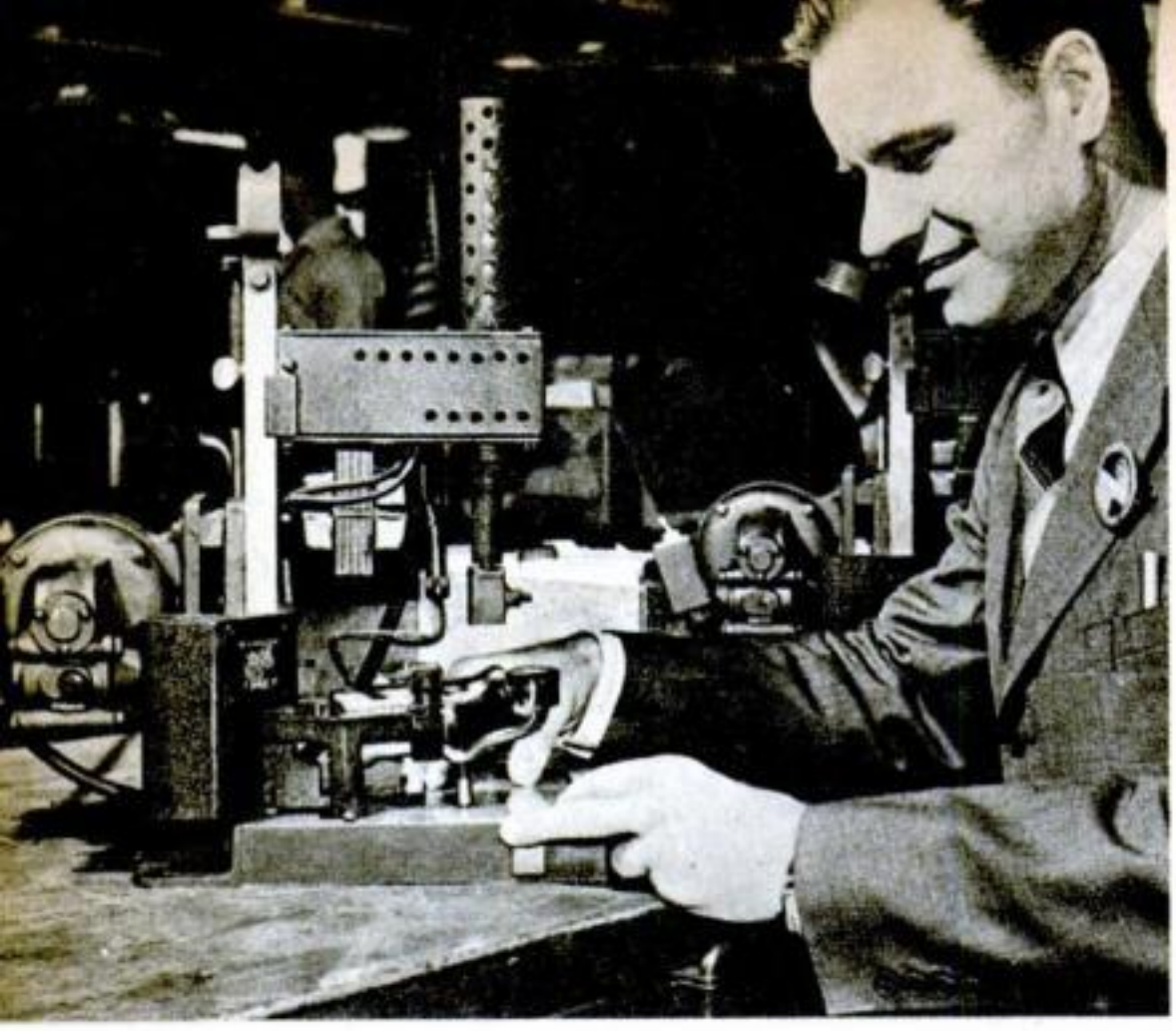
Your Pin Up—

U. S. NAVY PATROL TORPEDO BOAT

THEY are expendable, these mile-a-minute plywood sluggers, but the Japs have learned that they come high. From the early days of the war, when they dogged the Nip advance, to the day of vengeance in the Philippines, when one of them took on a whole enemy task force, they have turned their torpedo tubes and dual-purpose machine guns on anything that showed the Rising Sun.

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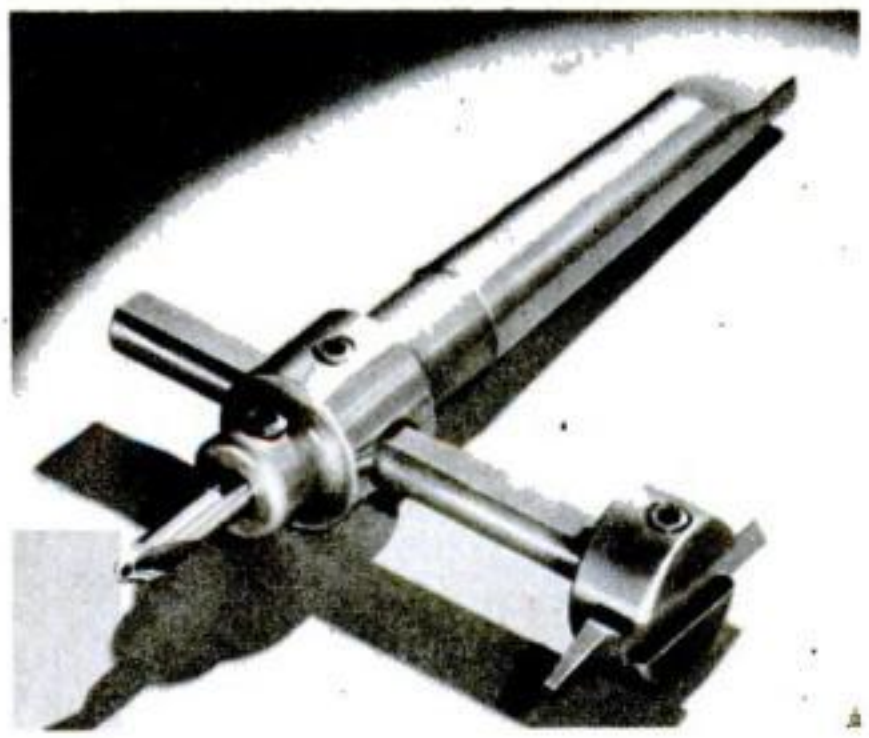


NEW Tools

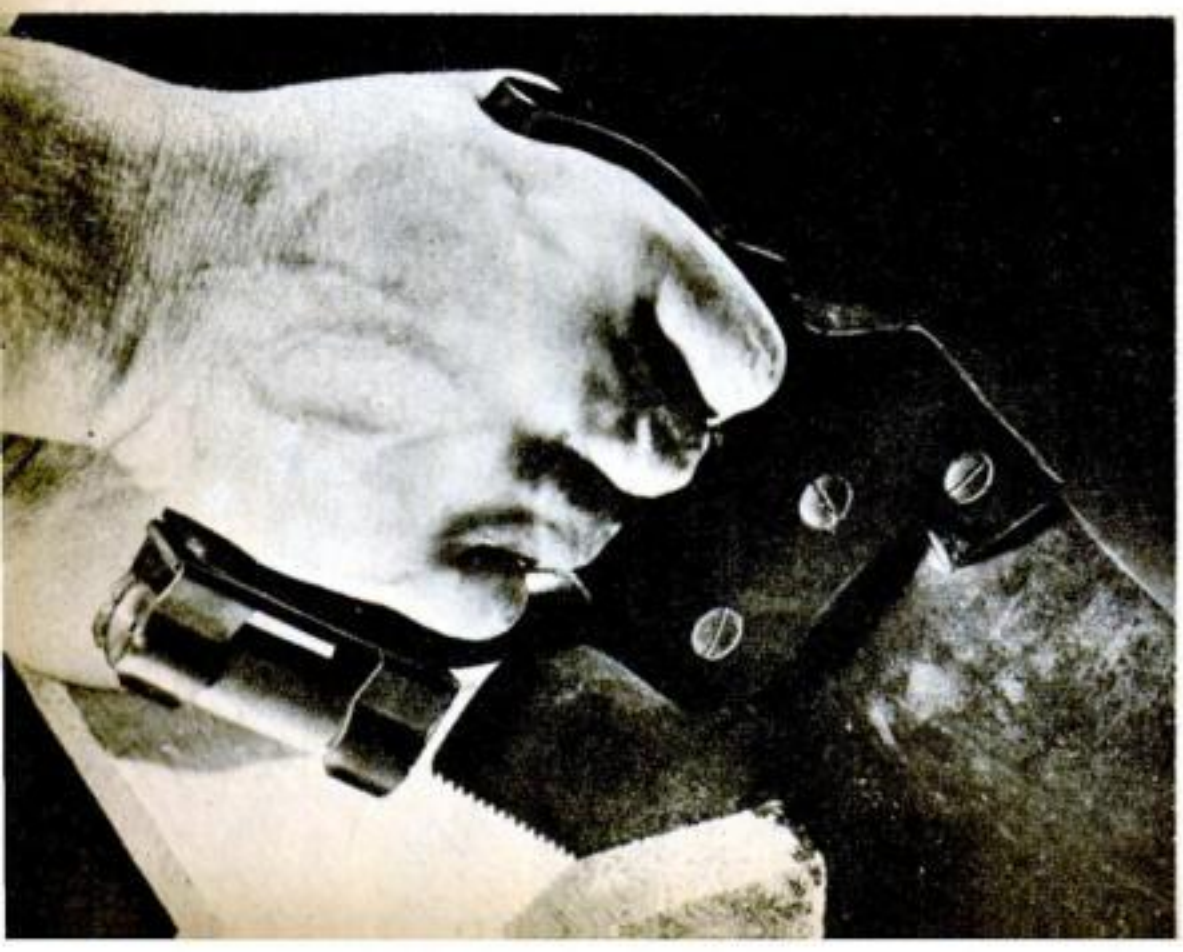
SAVES 1¼ SECONDS. The Martin Hardness Certifier, shown at left, is a mechanical device for testing and automatically certifying the hardness of sheet-metal parts. During 11 months' operation at The Glenn L. Martin Co., Baltimore, Md., the saving of 1¼ seconds on each of the 3,000,000 parts that went through the machine added up to more than 1,040 man-hours. Visual reading of a tester dial and hand stamping of inspected parts are eliminated.

TWO-WAY SWING on this bench vise permits it to be clamped in any position allowed by rotation on its base or a 180-degree turn of its jaw assembly. The rotation inside the base is controlled by a clamp screw long enough to project below the bench. The vise may be put on the market in kit form by the Level Machine and Tool Co., New Kensington, Pa., so that any home craftsman can assemble it.





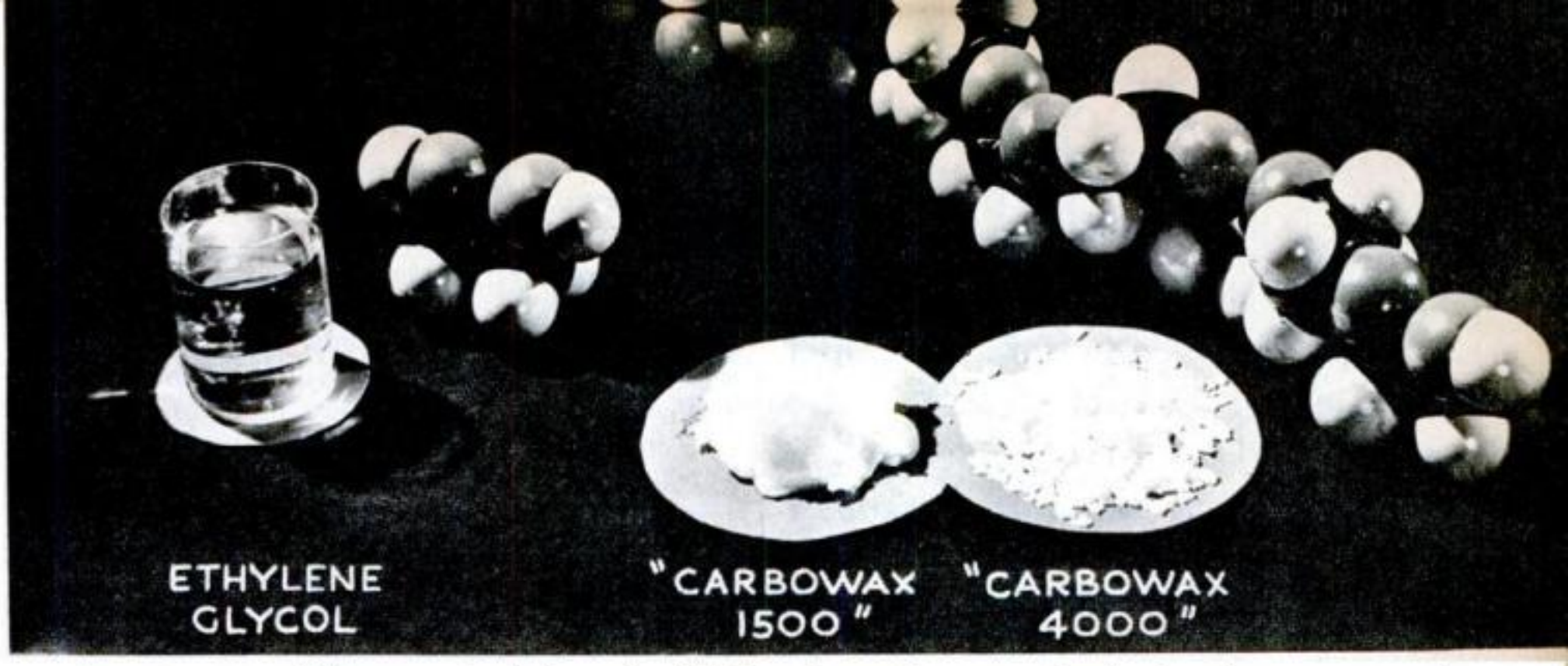
CUTTING ROUND HOLES two to eight inches in diameter in metal and other flat materials is accomplished with a circle cutter made by The Rieger Manufacturing Co., Miamisburg, Ohio. The tool fits in a lathe, drill press, or electric drill.



POUF! That's what a little device called Clerline, attached to the handle of a saw, does to the sawdust that accumulates over the line the workman is trying to follow. With every stroke of the saw, a jet of air is directed at the mark being followed, keeping it clear and making it easy to cut straight. There is a considerable saving of time and energy over the method of stopping to mouth-blow away the sawdust. This easily attached blower is made by Clerline, Weedsport, N. Y. It does not affect the balance of the saw.

POPULAR SCIENCE

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Basis of water-soluble waxes is ethylene glycol (left, with model of its molecule of carbon, oxygen, and hydrogen). Arranging such molecules in chains (upper right) produces compounds of any desired viscosity

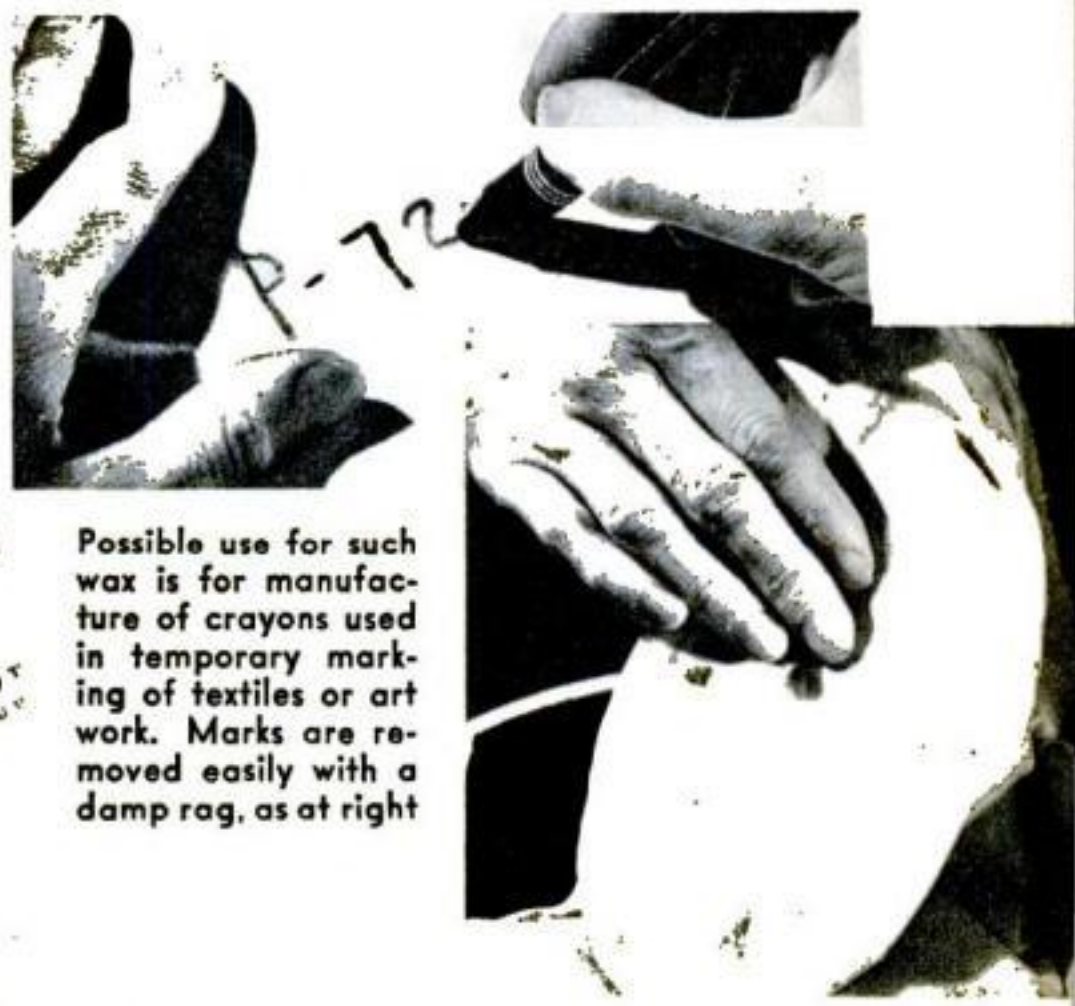
WAX THAT MELTS IN WATER

WAX will now dissolve in water. At least, waxlike compounds that have that property have been created by organic chemists who know how to make molecules stand around. One of these compounds has the consistency of petroleum jelly; another looks and feels like paraffin. Both have special uses, which can be broadened to cover lubricants, salves, and cosmetic bases.

These products of the Carbide and Carbon Chemicals Corporation are close relatives of ethylene glycol, whose molecules, with the help of heat, catalysts, and other magic, are induced to link together into long chains. As their length increases, the substance passes through successive states of viscosity, gradually becoming a harder solid. Unlike ordinary wax emulsions, the solutions of the Carbowax compounds are water-clear. These compounds have found wide use in war production and other industry and in fruit growing.



Carbowax 4,000, which is a solid that resembles paraffin, can form a 62-percent solution in water at room heat, making a crystal-clear, viscous liquid



Possible use for such wax is for manufacture of crayons used in temporary marking of textiles or art work. Marks are removed easily with a damp rag, as at right



These water-soluble waxes will also make paper transparent for tracing, while they leave a surface that takes ink and pencil

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Malaria

Sapping the vitality of whole races, it is one of the chief enemies of human progress. Do you know the amazing story of its origin and how it spreads?

By ALDEN P. ARMAGNAC

Color photography by
ROBERT F. SMITH and JULIUS WEBER

IN THE Far East, a formidable ally of Japan confronts our armed forces. On the home front, a fifth-column agency kills 3,000 Americans and inflicts 2,000,000 casualties a year. The same potent menace may well have caused the downfall of the ancient Greek and Roman civilizations.

Its name is malaria. The mosquito-borne, chills-and-fever malady ranks as No. 1 disease of the tropics, and, some highly qualified opinion holds, of the world. For while such ailments as typhus and influenza may cause more fatalities, Dr. Morris Fishbein points out, malaria makes many more people sick—and in many parts of the globe it is, unfortunately, as common as poverty.

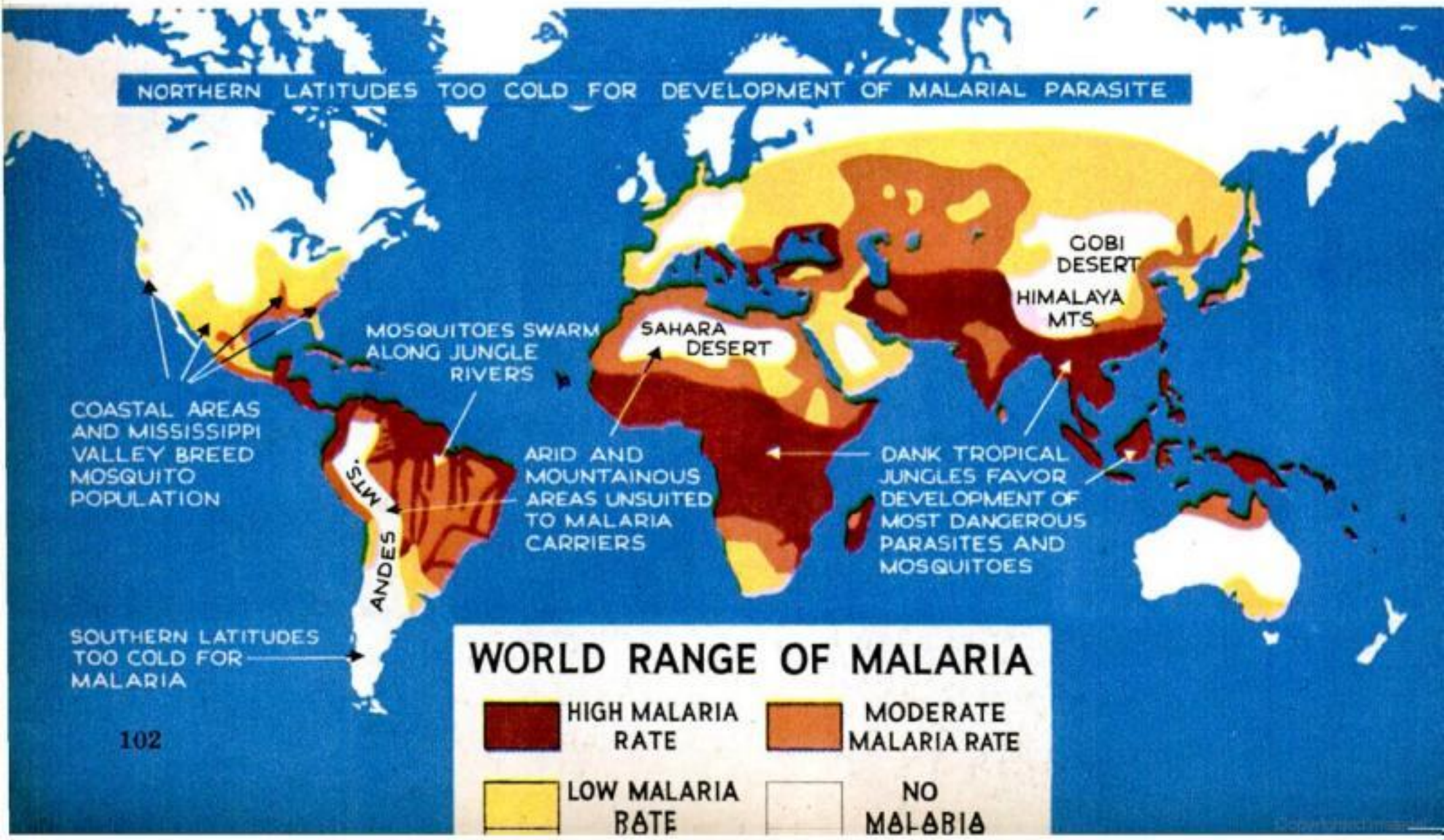
Stamping out malaria not only would help win World War II, but also confer far-reaching postwar benefits. For example, one estimate cites the annual number of malaria cases in India as 100,000,000—more than a quarter of the entire population! Eradicating the disease would transform India into one of the world's most prosperous countries within a single generation.

Headline news, therefore, is a recent report of the National Research Council's Board for the Co-ordination of Malarial Studies. No longer, it states, are large supplies of quinine—cut off by Japanese invasion of the Dutch East Indies—considered important for treating malaria cases among service men. A newly mass-produced synthetic drug, variously called atabrine or quinacrine, excels the old-time remedy as both a preventive and cure, in a treatment developed by three years of intensive research. Commenting on the report, the ultraconservative Journal of the American Medical Association says, "The postwar world, with the knowledge now available about this drug and on methods of malaria prevention, should be able to eliminate malaria from every civilized nation. That would be, indeed, a blessing derived from the most destructive and costly war the world has ever known."

Spurred by sheer military necessity, to-

WHERE MALARIA IS FOUND

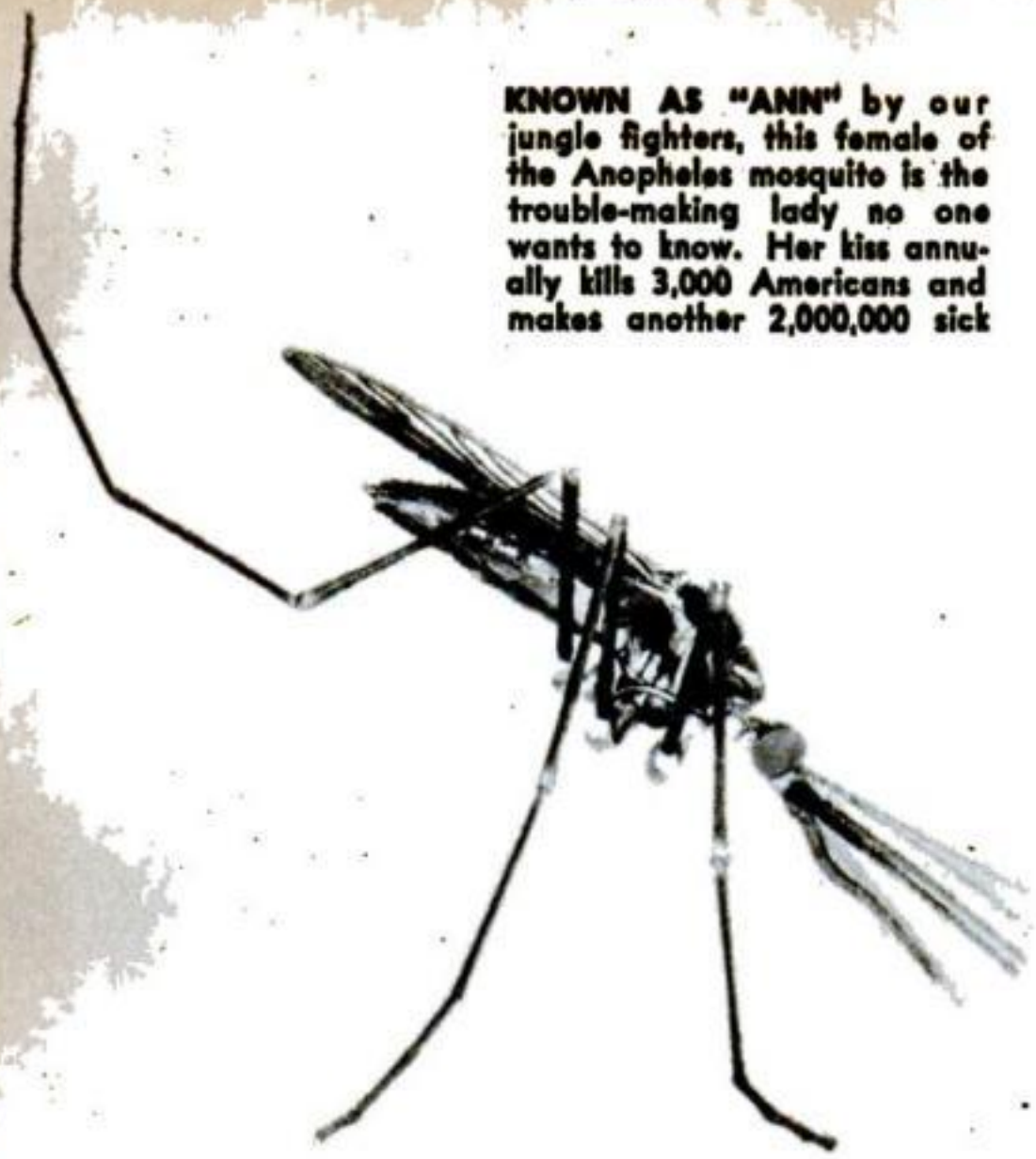
Humans are subject to four types of malaria: vivax, malariae, ovale, and falciparum, the first two ranging from the U. S.-Canadian border to southern Argentina, and from Leningrad, Russia, to the tip of Africa. Ovale malaria also occurs in Africa and the Philippines. Virulent falciparum blights the tropics



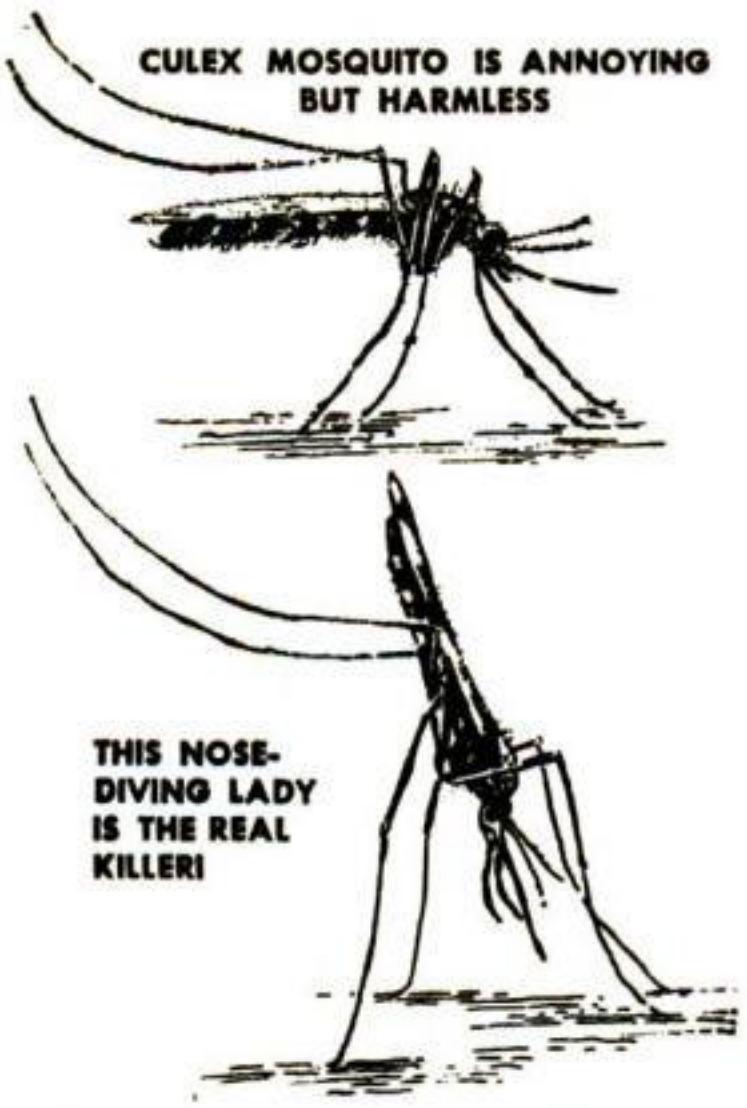


POPULAR SCIENCE PHOTOGRAPHS DEADLY FALCIPARUM MALE CELL

Here, for the first time in any magazine of general circulation, is shown a mature male cell of the falciparum parasite, which is responsible for one of the four known kinds of malaria. Magnified more than 5,000 times, this remarkable color photograph reveals the parasite as it might appear in the stomach of an anopheles mosquito that has just dined off the blood of a malaria carrier. Falciparum, or "malignant," malaria is the deadliest form of the disease and proves fatal in a few days without treatment. However, it also responds most readily to medical aid.



KNOWN AS "ANN" by our jungle fighters, this female of the Anopheles mosquito is the trouble-making lady no one wants to know. Her kiss annually kills 3,000 Americans and makes another 2,000,000 sick



CULEX MOSQUITO IS ANNOYING BUT HARMLESS

THIS NOSE-DIVING LADY IS THE REAL KILLER!

MALARIA IS CARRIED ONLY BY FEMALE ANOPHELES MOSQUITO

Although she is to be avoided, "Ann" is not to be overfeared in northern latitudes, for she's dangerous only if she has first bitten a malaria victim

She is quickly spotted by the way she alights nose down, tail high, in contrast to Culex mosquito who makes even-keel landing. Both insects have six feet

day's strides toward the conquest of malaria crown centuries of search for its cause and cure. Hippocrates, the famous Greek medical pioneer of the pre-Christian era, recognized the symptoms of the disease as clearly as any modern doctor might.

During a preliminary period, a patient complains of vague aches and pains. From 10 to 17 days after infection, trouble really starts. First comes a severe chill, usually lasting about an hour; next, a three- or four-hour fever, which may rise as high as 105 degrees; and, finally, two to four hours of sweating. Lasting a total of six hours, on the average, the whole paroxysm passes as suddenly as it came. It recurs with characteristic regularity at intervals of 72 hours, 48 hours, or less—until, eventually, the patient recovers or dies. Hippocrates knew these different cycles, but not their explanation. Now we know the reason—of which more presently.

Solution of malaria's mysteries began in 1881 when Alphonse Laveran, a French military physician, first observed malarial parasites in blood samples of troops in Algeria. The microorganisms were not bacteria, but protozoa, which placed them in the animal kingdom. They received the family name of *Plasmodium*, meaning "like protoplasm," followed by the individual name *"malariae"* for malaria. Hardly had Laveran made his signal discovery when two other kinds of malaria parasites turned up—*Plasmodium vivax*, so christened for its lively behavior, and *Plasmodium falciparum*, named after its sickle shape. Addition of the oval-shaped *Plasmodium ovale*, recognized as a new species in 1922, has completed the list of parasites responsible for the four known kinds of malaria.

Which kind of parasite infects a malaria patient makes considerable difference to him, for it determines the severity of the disease and the interval between paroxysms of fever. Also, his chance of catching one kind or another depends largely upon its geographical distribution.

Widest in occurrence, the mild form called "benign" or *vivax* malaria ranges from the Canadian border and the vicinity of Leningrad, Russia, down to southern Argentina and the southernmost tip of Africa. *Ovale* malaria, of the Philippine Islands and Africa, has even milder symptoms. In both types, the 48-hour cycle is characteristic.

Malariae malaria, of medium severity, covers about the same range as the *vivax* form, but its occurrence is comparatively rare. Sufferers normally recover even without treatment. This type has a 72-hour fever cycle.

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ELECTRON MICROSCOPE PHOTOGRAPHS TINY SPORES

Seed of all the trouble is this tiny spore, shown here enlarged about 10,000 times by an electron microscope (left). When a malarial "Ann" jabs her tubelike "spear" into your skin, she injects saliva filled with hundreds of these spores. From the saliva you get a typical "mosquito-bite" swelling. From the spores you get malaria

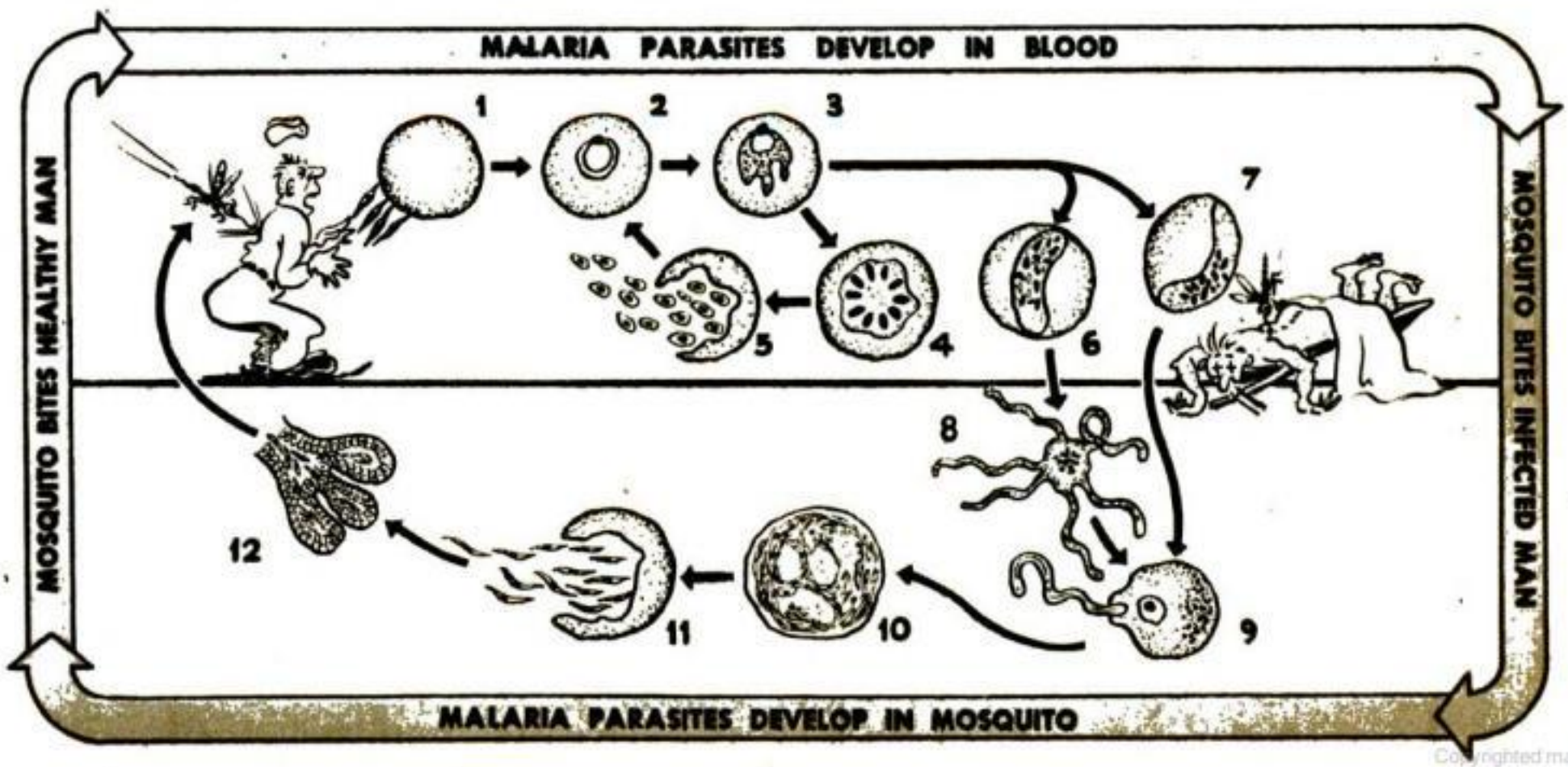
"Malignant" or *falciparum* malaria, the real killer of the group, inhabits the tropics. Violent seizures of fever occur every 36 to 48 hours. Failing prompt treatment, death follows infection in only a few days. But the killer type responds most readily of all to medical aid, and complete recovery is the most rapid.

How malaria was transmitted puzzled early experimenters. Greeks and Romans of ancient days thought that night air was bad for them—and rightly. What they didn't know was that malaria-carrying mosquitoes have nocturnal flying habits. It remained for a Britisher, Ronald Ross, to demonstrate in 1898 that certain mosquitoes transmit a parasite of animal malaria among birds; and for a pair of Italian experimenters, Grassi and Bignami, to show almost simultaneously that mosquitoes of the *Anopheles* group carry the parasites of human malaria.

Quite likely "Ann," as our jungle troops know the bloodthirsty female, pays frequent calls at any home along the United States coasts or the Mississippi Valley. A visit from one of Ann's malarious breed need cause little alarm, however, in northern latitudes where cases of the disease are infrequent. For she cannot possibly trans-

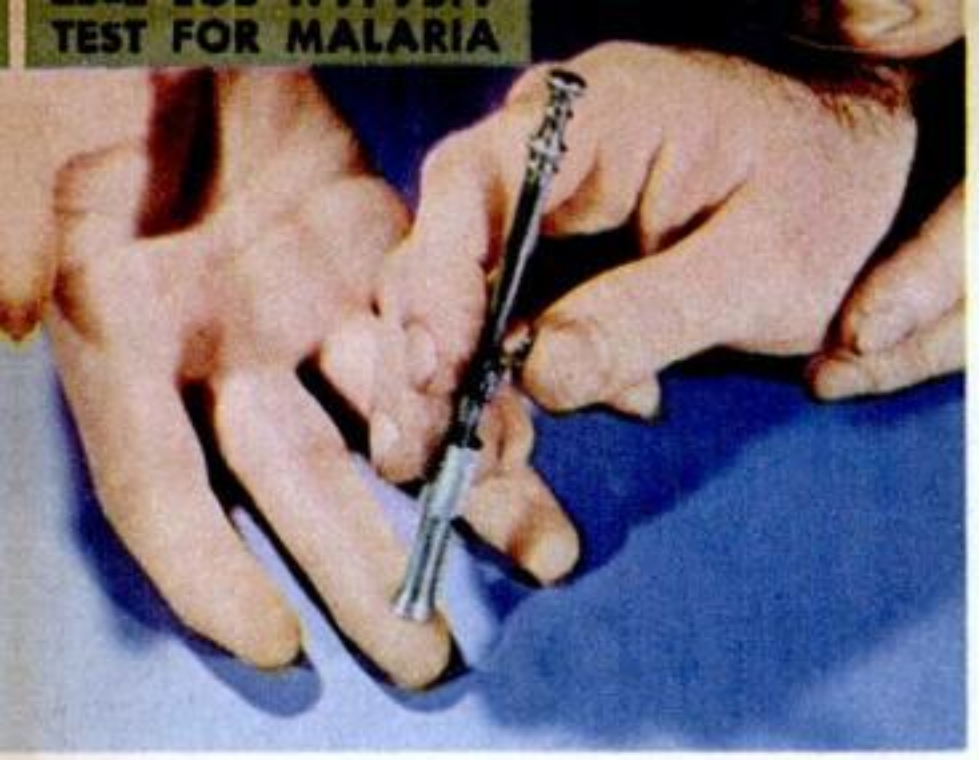
SIMPLIFIED DIAGRAM OF THE MAN-TO-MOSQUITO-TO-MAN CYCLE

Once a spore gets under your skin and into your blood stream it heads for a red corpuscle (1). Penetrating the corpuscle, it takes the form of a ring with a setting (2). From there it turns into a bloblike form (3) that divides into segments (4)—feeding all the while on the contents of the corpuscle. Eventually the cell bursts, scattering the spores back into the blood (5). An alternate course for the parasites is to develop into male (6) and female (7) sex cells, which are then picked up by the mosquito. Streamers from male cells (8) then fertilize female cells (9) to become cysts (10) that eventually rupture (11), releasing spores into mosquito's salivary glands (12). One good bite by the anopheles female, and the vicious cycle is complete



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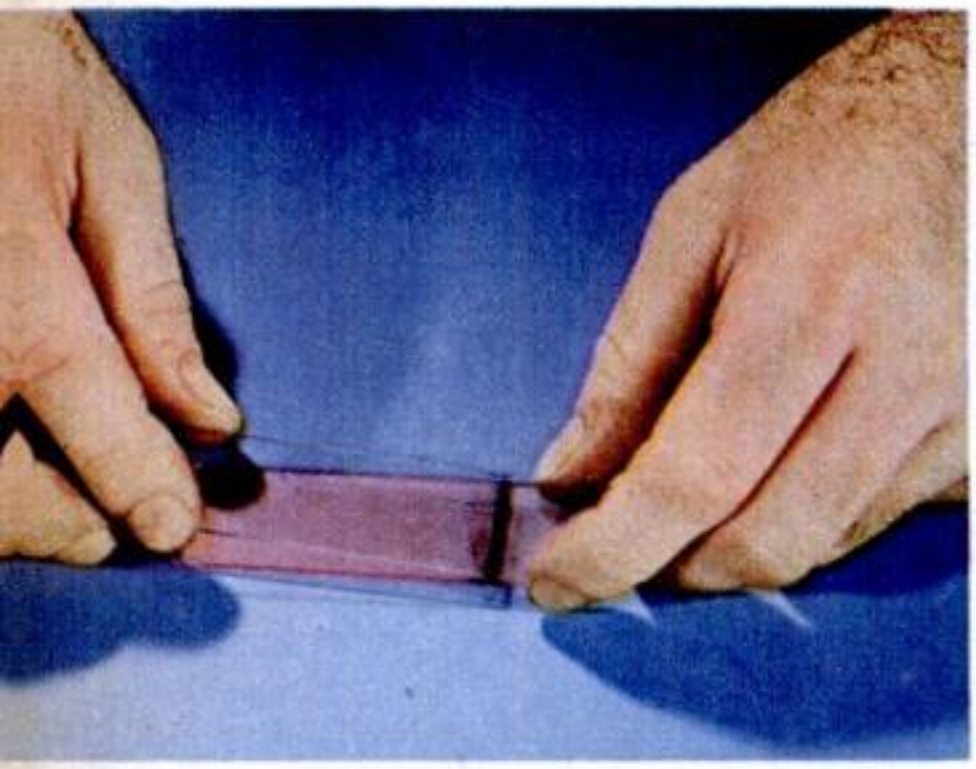
TEST FOR MALARIA

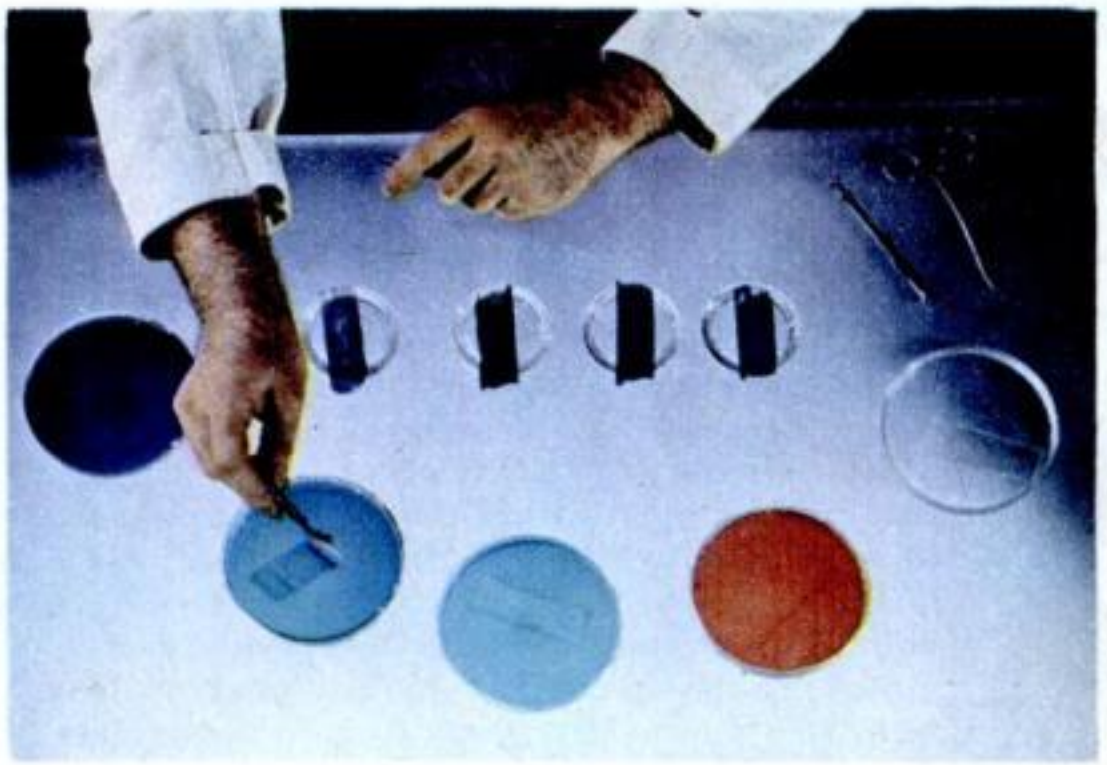




1 To make a blood test of a person suspected of having contracted malaria, a spring-operated point is jabbed lightly into the patient's finger

2 After enough blood has been allowed to accumulate to provide an adequate specimen, a glass slide is pressed against the tip of the finger to get a "smear"





3 The end of the first glass slide is then carefully drawn across the face of a second so as to spread the blood into a comparatively thin film

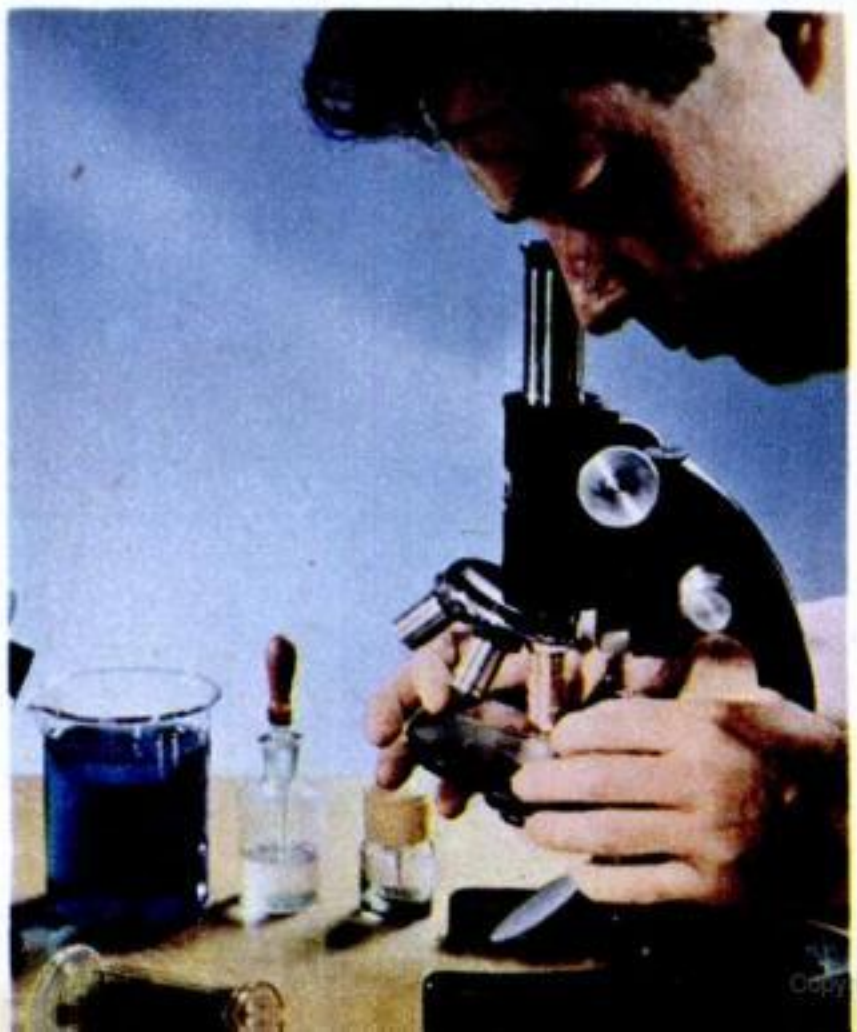
4 To bring out details that otherwise would be invisible, first slide is dipped into various stains which are selectively absorbed by various parts of parasite

mit malaria unless she has first sucked the blood of a malarial patient. And that is a part of a fascinating story, rarely if ever to be found outside the pages of costly and hard-to-read medical textbooks.

Truly a wonder of nature is the life history of the malaria parasite, of the ever-changing forms it assumes during its non-sexual life in the human body, and of the completion of its sexual life and reproduction in the mosquito. Only now are scientists approaching the explanation of all its mysteries. And it still seems strange that the process does not inconvenience the mosquito in the least, while it proves so troublesome to man.

Ann's bad table manners start the trouble. Like harmless *Culex,* she injects some of her saliva through the needlelike tube she has poked through your skin. It will neutralize the chemical that makes human blood clot, so that she may drink it freely. This is annoying enough from *Culex,* for the irritating fluid causes the typical swelling of a

5 Under a microscope the stained slide presents a colorful view (similar to those at the right) which aids the observer in making an accurate analysis. New techniques now also make it possible to distinguish one type of malaria germ from another



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HOW PARASITE GROWS IN THE BLOOD STREAM



◀1 The spore, initial form of the malaria parasite. One "bite" of infected mosquito injects myriads of these into your blood



2 Penetrating red corpuscles, the spore develops into the form of a "signet ring." Quinine or atabrine treatment at this stage usually brings recovery ▶



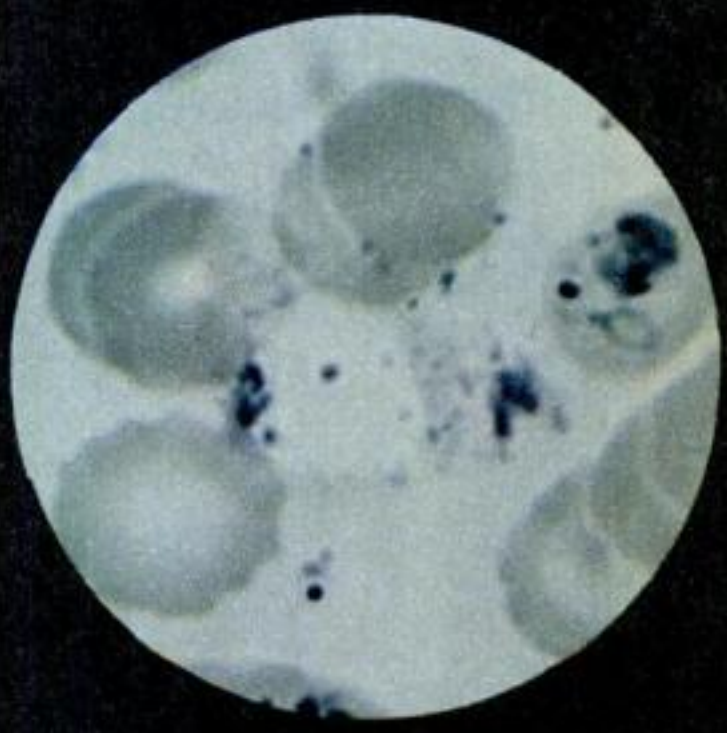
◀3 Here "signet ring" forms have become breakable forms known as schizonts. The germs in pictures 1 to 7 are enlarged 2,000 times



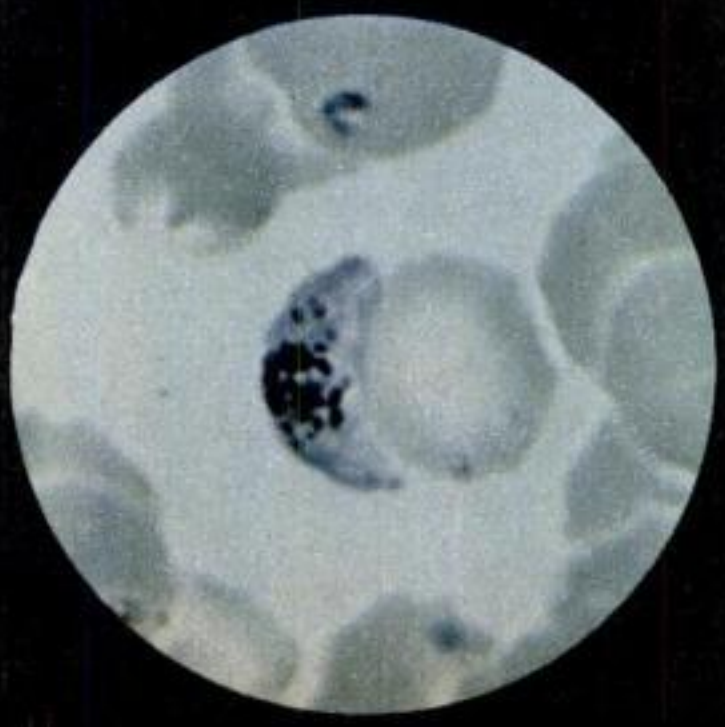
4 Mature schizont when it is just about ready to burst the corpuscle. Millions of these cells exploding at the same time are responsible for the victim's chills and fever ▶



◀5 The exploded corpuscle. Some of released parasites will enter other corpuscles, again form signet rings, and repeat cycle



6 Here the malaria parasites are shown being scattered in all directions into the blood stream. Red corpuscle is left behind, blasted to bits ▶



◀7 Some of the parasites that do not repeat the "schizont cycle" then turn into mature sex cells, which, in the deadly falciparum type, assume crescent shape



8 Parasite clumps in the stomach of a mosquito. Eventually they will enter the mosquito's saliva glands. (Subject is enlarged over 100 times) ▶

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QUININE, ATABRINE, PLASMOCHIN ARE THE BIG GUNS OF THE WAR NOW BEING WAGED ON MALARIA



Synthetic drugs have been developed which do just as good a job as quinine. Atabrine (above in tablet form) and plasmochin are two of our best weapons in fighting malaria



Two million cinchona seedlings, flown out of Corregidor just before the Japs bludgeoned their way in, are shown being tenderly nurtured under glass by U. S. Department of Agriculture. They represent a potential new source of quinine

KEEPING THE DISEASE OUT OF THE U. S. A.

On the theory that one good way to beat malaria is to slam the door in its face, planes and ships arriving in the U. S. from malarial countries are given a careful going over by our immigration authorities



mosquito bite. But if Ann is infected with malaria, she adds injury to insult by implanting the spores of the malaria parasite, too. Suggesting string beans in outline, these mischief-making objects are so tiny as to tax the power of fine optical microscopes, and it takes an electron microscope to give a layman a good look at one of them.

Soon after a spore lodges under the skin, it finds its way to the blood stream and penetrates a red corpuscle, which will serve it as a temporary home. It has performed the first of the quick-change acts that make it remarkable. For now it has taken on the form of a perfect ring, with one or two enlarged spots resembling jewel settings. This is the first stage at which a doctor can diagnose "killer" or *falciparum* malaria.

Now the ring successively turns into a blob called an ameboid form, develops into wormlike "schizonts," and divides into a number of segments, feeding on the contents of the corpuscle meanwhile. Eventually the red cell bursts, scattering the divisions of the composite parasite into the blood. Simultaneously the patient suffers his attack of chills and fever, the cumulative effect of many corpuscles rupturing at once, with the possible release of malaria toxins into the body.

As for the released parasites, which enter fresh red cells, two courses are open. Some repeat the cycle that leads to rupture and scattering. Others go on to develop into mature sex cells. Those of *falciparum* malaria resemble sausages and crescents, the female cell being longer and more pointed than that of the male.

This completes the growth of the parasites in their human host. They are ready to start life anew in the mosquito. Its bite sucks in the patient's blood and all the kinds of parasites it may contain. All are digested and destroyed except the mature sex cells, which somehow (*Continued on page 210*)

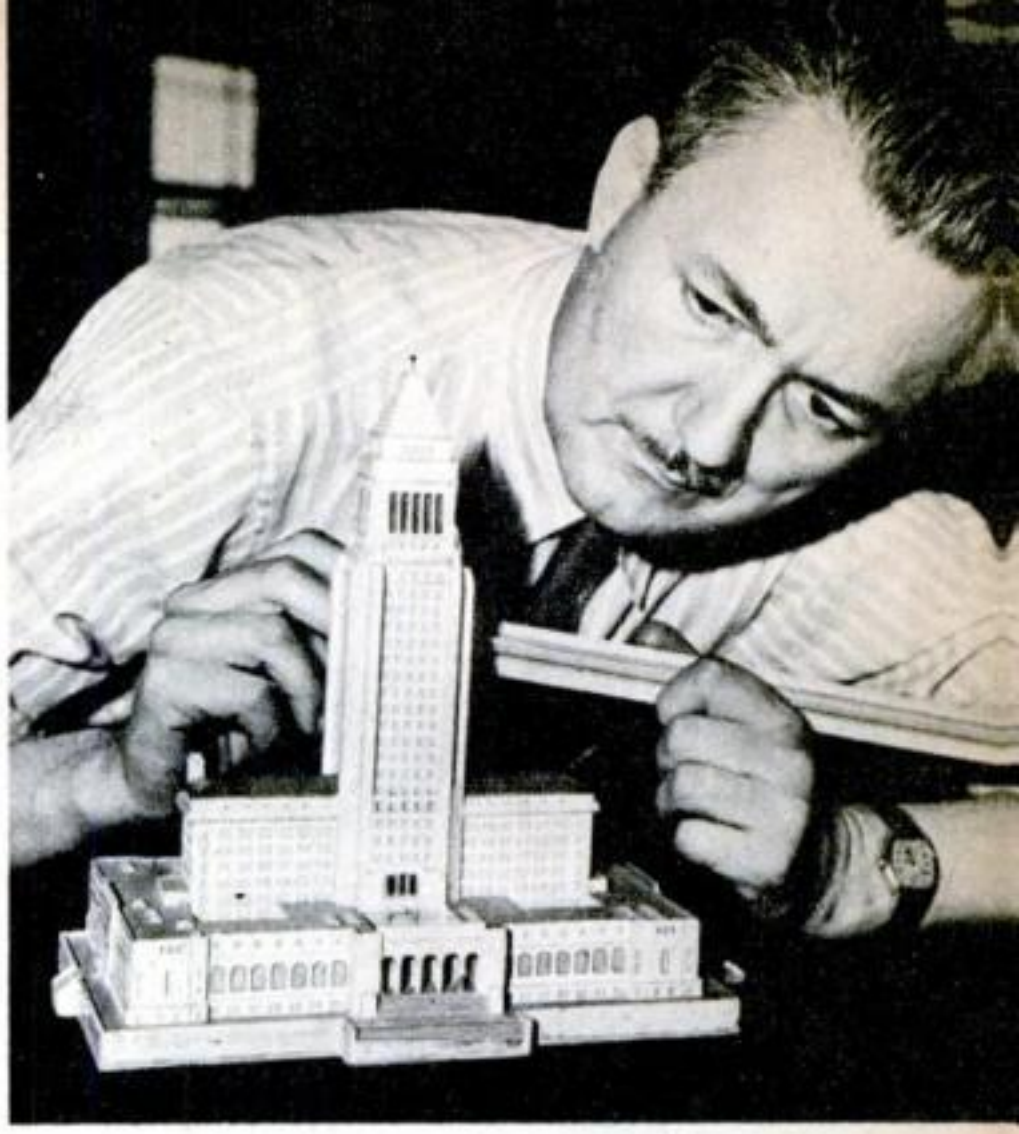
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Model Shows What's Ahead for Cities

By ANDREW R. BOONE

LOS ANGELES is being modeled in a big way, as an aid to its engineers in launching postwar projects and developments to keep pace with the rapid growth of population. The first of a series of models, and the largest of the group planned, reproduces a section of 7.4 square miles in the downtown area. It is made of sugar pine and is painted the colors of the buildings and projects represented. Even though built to a scale of one inch to 50 feet, the model is impressive in size; it includes 65,000 buildings and measures 24 feet square. It looks a good deal like a view from an airplane at 1,000 feet. It was constructed at a cost of $100,000 under the supervision of Lloyd Aldrich, city engineer, and, in connection with the rest of the projected series, will help in solving the problems relating to traffic parkways, structural developments, beach improvements, building safety regulations, and a civic center development.

With a present estimated population of more than 1,750,000 and an area topping that of Greater New York, Los Angeles is meeting its problems of future development with foresighted concern.



Here the miniature replica of Los Angeles' city hall is being scaled by technician F. J. Ostronic. It includes 1,200 pieces of wood; construction required six months

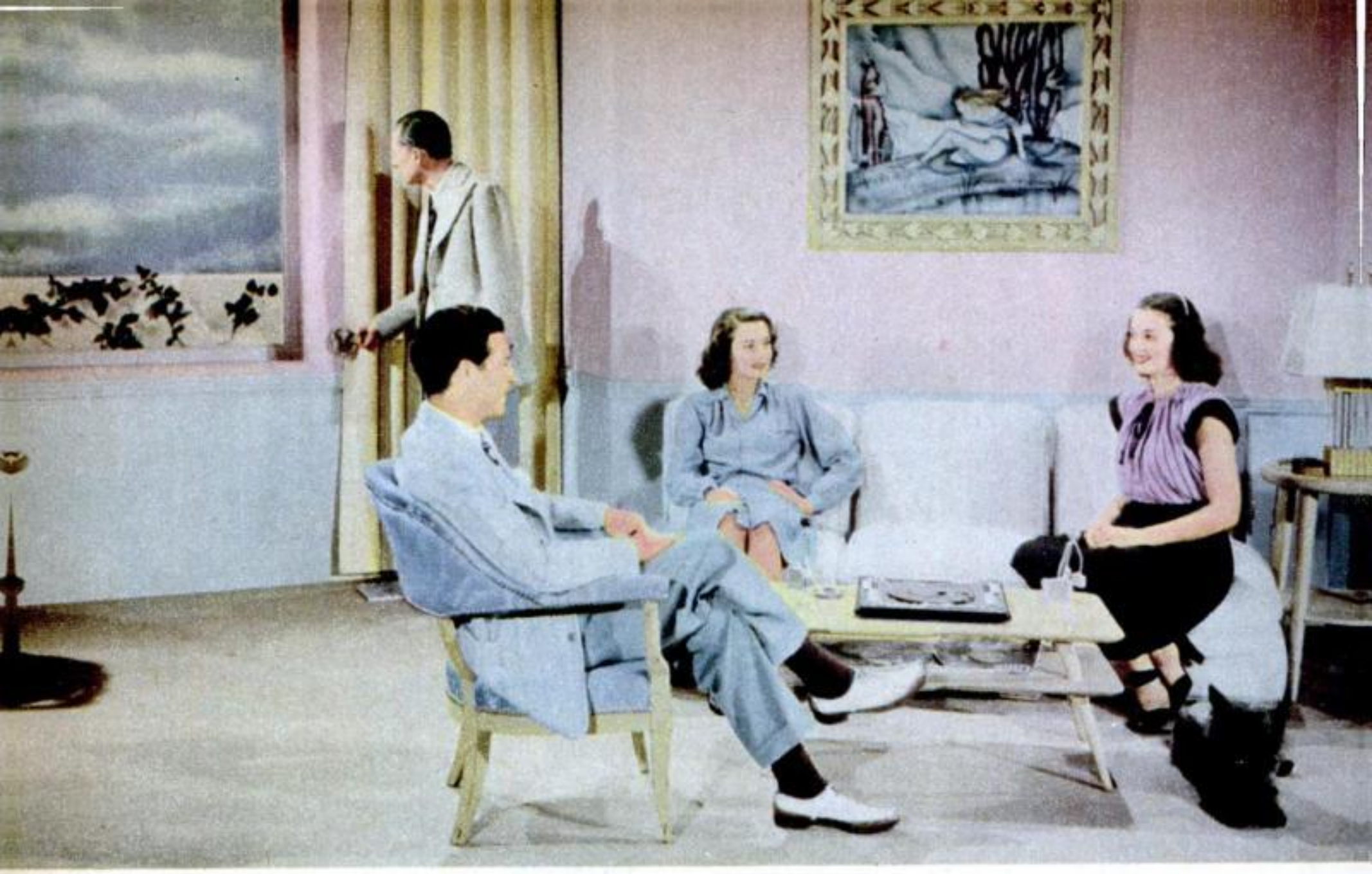


Giant model of the Los Angeles downtown area shows 65,000 buildings on a scale of one inch to 50 feet. It covers 576 square feet and took 75 man-years to build. Detail below shows the section devoted to the big Southern Pacific railroad yards and shops, including roundhouse

Future is being mapped by planner for safety walks, underpasses, and similar needs that are likely to arise in postwar years at the Belmont High School







At a pause in a cardless bridge game, the host adjusts the polaroid windowpanes to reduce the glare from the sun. Turning a crank rotates circular pane

YOUR *Living* ROOM...TOMORROW

NEW TRIUMPHS OF SCIENCE PROMISE COMFORT, PLEASURE

A PREVIEW of the comforts and conveniences you will enjoy in your postwar home is afforded by a new "Popular Science" film produced by Jerry Fairbanks in co-operation with POPULAR SCIENCE MONTHLY.

Stills reproduced on these pages show a few of the ways in which recent scientific developments, to be available after the war, will contribute to the pleasures of living. Not in evidence here, but at least equally important, is the air-conditioning and purifying system that will supply germ-free air of any temperature and humidity desired. Even the dog is not forgotten; he has an electric-eye door for his own use.

YUM! Steaks from the snack bar shown on the opposite page are broiled to sizzling perfection before the guests' eyes at this knee-high fireplace. When a button is pressed, a grill of heat-resistant glass tubes slides out into position above the grate, which is made of the same material. Isn't science wonderful!



WHEN DO WE EAT? Even in the World of Tomorrow, people will get hungry. A blinking light beside the fireplace conveys a signal from the postwar maid in the kitchen. The hostess walks over to the well-filled bookshelves. No, she's not looking for food for thought. A little pressure on the end of a shelf and . . .





PRESTO! Two shelves swing around, books and all, like a revolving door. In place of the mystery stories and other deep literature, we see a two-shelf snack bar, on which the maid has arranged all the makings of a feast. The steaks are uncooked, ready for the host to display his prowess as a chef at the fireplace, as shown on the other page. (Note to the ladies: If the "maid" still insists that she'd rather be a riveter, you can do her part of the act ahead of time)



—AND SO TO BED. After the guests have gone home, milady will probably enjoy the luxury of a bath and dressing room like this. From another "Popular Science" film, this photograph shows how glass-block walls and modern lighting fixtures will add new zest to the all-important ceremony of making the toilette. Fluorescent lamps will make it easy to adapt cosmetics to any kind of lighting



JANUARY, 1945

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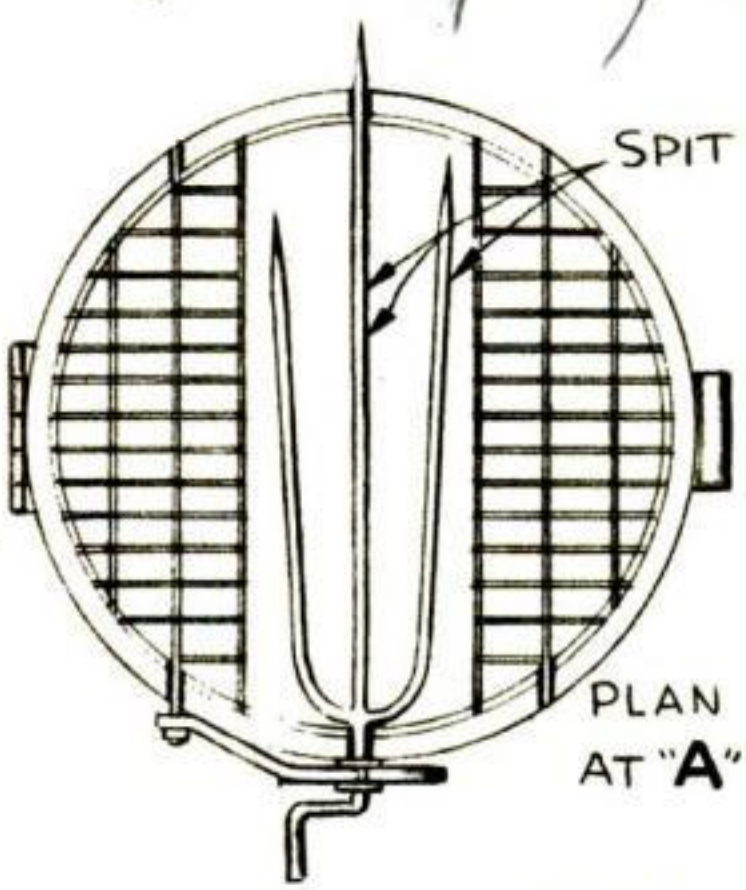
new ideas

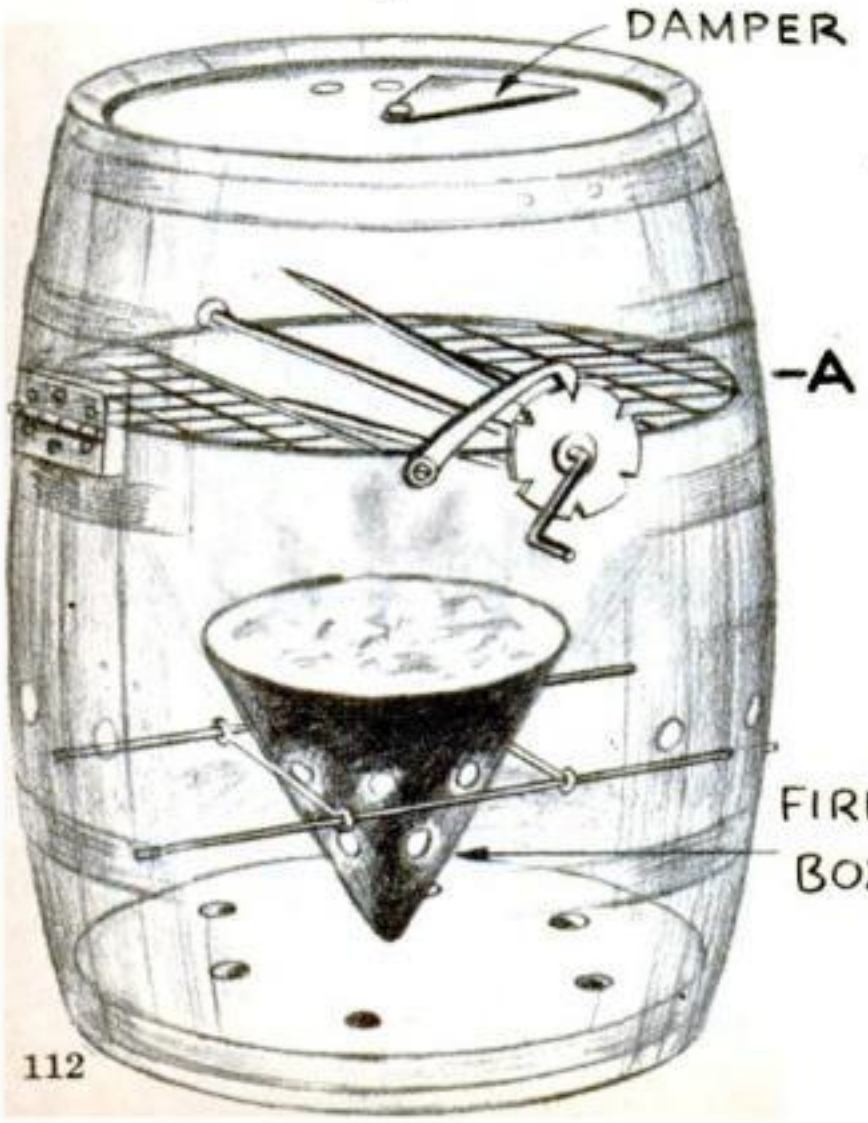


SILKEN CHIN should follow the use of a safety-razor device invented by Soll Rothner, of Jamaica, N. Y. Into the handle, just behind the conventional cutting head, is introduced a magnifying lens so positioned as to give the shaver an enlarged view of the portion of his face that is getting a once-over lightly. The operator is thus enabled to avoid missing patches of whisker that might be overlooked in the ordinary course of shaving. The frame is made of any suitable material, and the magnifier can be of plastic.



MOTOR-DRIVEN CAN OPENER is the idea of Elizabeth M. Scott, Los Angeles, Calif. Superficially it resembles the familiar type of opener with the fixed blade that hooks under the tin cover. Above this, however, is a rotating cutter operated by an electric motor directly in front of the handle.





FLAVOR OF OLD WINE will be imparted to barbecued meats by the use of this spit in a wine cask above a charcoal firebox. The novel outfit was devised by John Gorman, of Los Angeles. The spit, centered between two stationary segments of an auxiliary grill, is located just above the midsection of the barrel, and is turned by a handle extending outside. It can be held in position by a ratchet and pawl when rotation is unnecessary. Holes at the bottom of the barrel and a damper at the top control the required drafts. Top third of the barrel is cut and hinged for access to cooked meats or other food and also for replenishing fire and cleaning.

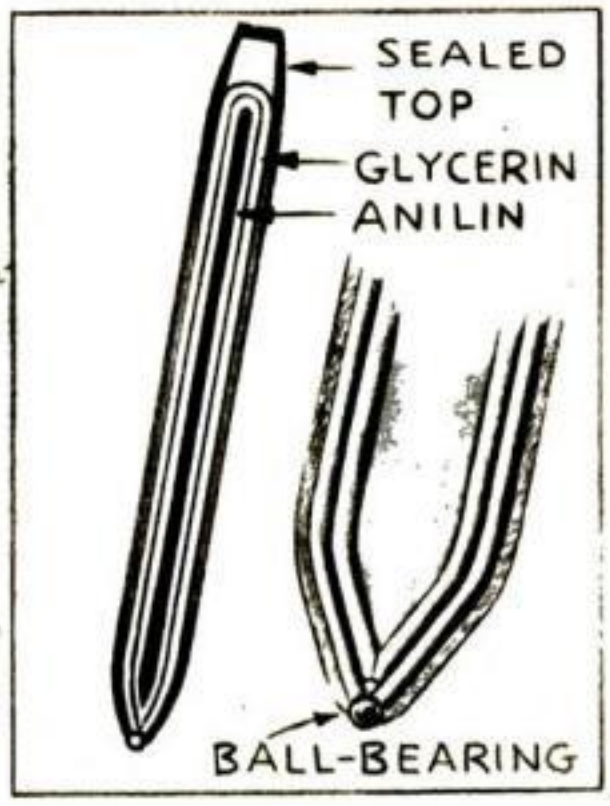
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from the inventors

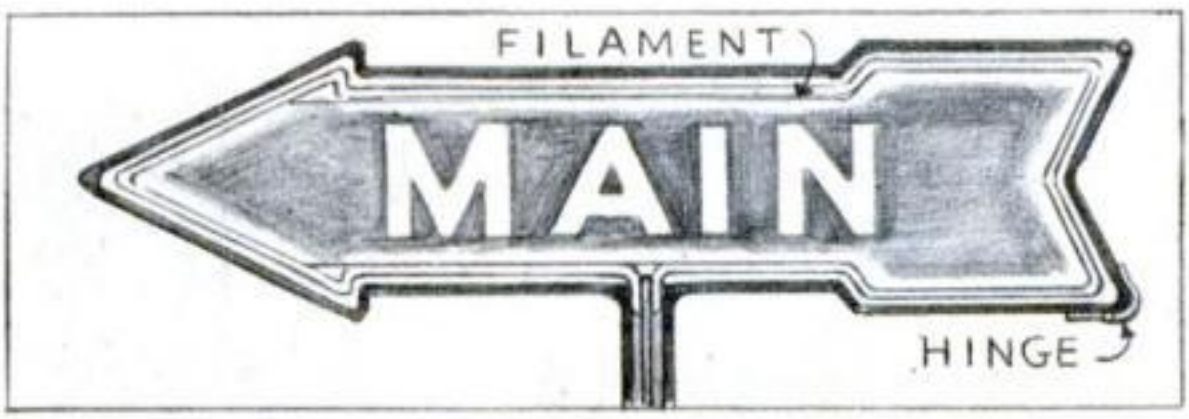


HORSESHOES OF PLASTIC may replace those of steel if the invention of Gordon Alexander Allan King, of Kew, England, proves itself in everyday use. The new shoe is designed to overcome such objections to steel shoes as weight, lack of elasticity and resiliency, and tendency to become slippery. The plastic employed includes a large percentage of rubber through which are dispersed vegetable and animal fibers and fillers to increase the shoe's gripping powers. It is of a special design to fit the horse's hoof, and no heat is required in its application. Moreover, the shoe will expand as a whole with a growing hoof. Because nail holes do not extend entirely through, a firmer grip is established when the shoe is nailed on.





TWO-YEAR INK SUPPLY can be carried in a fountain pen invented by L. J. Biro, an Argentine newspaper man from Hungary. The writing point is an unbreakable ball bearing to which a gelatinous quick-drying ink is fed from a copper tube. Composition of the ink is not divulged, but is supposedly a combination of glycerin and anilin fed from two copper tubes. The pen is sealed and can be refilled only by the manufacturer. The inventor claims that the pen will not leak at high altitudes, and that one filling lasts one to two years.



NO EXCUSE FOR GETTING LOST in any large city at night will be valid if the new street guide devised by Herbert Meyer and Edna M. Spiegel, New York City, is put in use. The invention covers the after-dark illumination of street signs and the redesign of the usual rectangular plates bearing the names. Electric wires leading up through the standard connect with a heating-element wire outlining the arrow-shaped sign. When the current is turned on at nightfall, the resulting glow makes the location apparent even on the darkest night. Surrounding the sign is a casing made of heat-resisting glass or other suitable material, with facilities for opening and servicing the direction indicators with the least possible trouble.



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INSIGNIA AND UNIFORMS OF THE JAPANESE ARMY



CAP EMBLEM, IMPERIAL GUARD



ARM INSIGNE, INFANTRY

AMERICAN fighters who are facing the Japs in the Far East must be able to tell at a glance the rank and branch of service of any enemy they kill or capture. Instruction in the Army Orientation Course has familiarized them with the uniforms and insignia worn by their foes in the jungles of the South Pacific and on the continent of Asia. Pictures on these pages show typical uniforms and insignia.

In general, the Japs have imitated the military organization of the Occidental powers. As in our own Army, their officers' uniforms are not government issue, and this causes considerable variation in color and cut. Swords are non-regulation and may be carried by noncommissioned as well as commissioned officers. In many cases, the swords have been handed down for generations.

Insignia of rank, for both officers and enlisted men, are worn generally as collar tabs. Zigzag arm bands of different colors denote branches of service, such as aviation, tank, and infantry.

UNIFORMS WORN BY



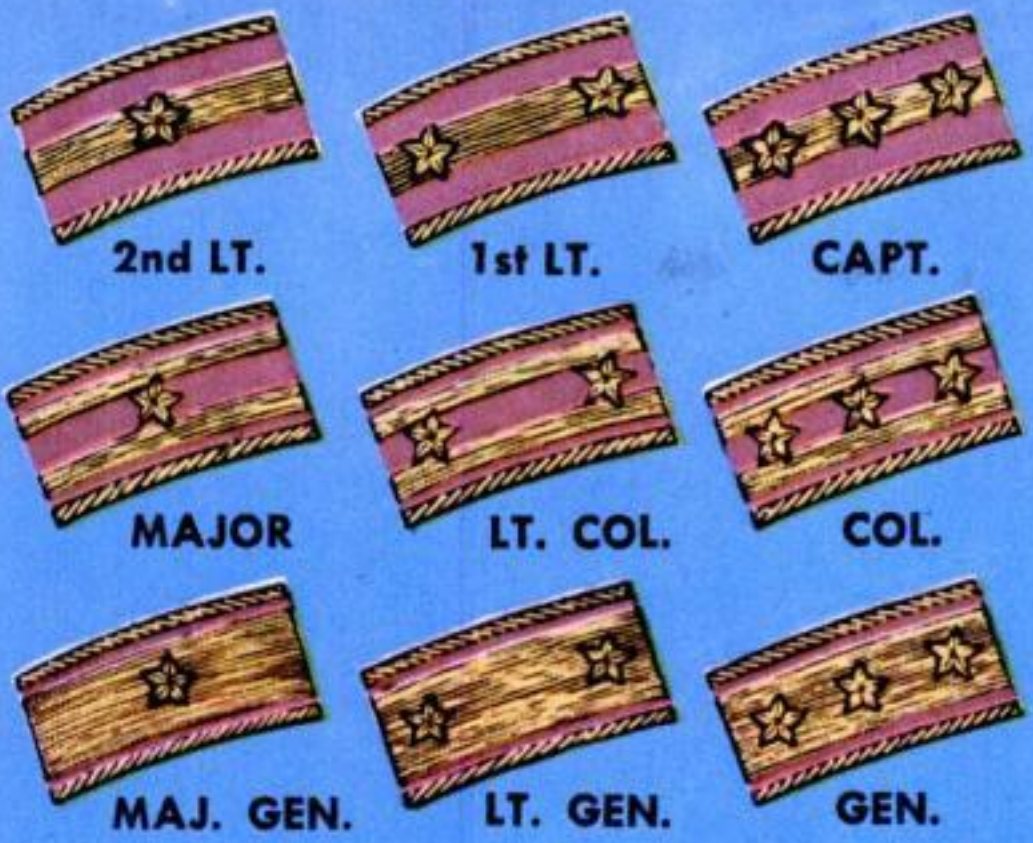
COLONEL, FIELD DRESS



SECOND LIEUTENANT, SUMMER FLYING SUIT

INSIGNIA OF RANK

OFFICERS



ENLISTED MEN



JAP OFFICERS AND ENLISTED MEN



FIRST LIEUTENANT



INFANTRY RIFLEMAN PRIVATE



CAMOUFLAGE JUNGLE JACKET

A Cook Becomes a Hero

Drawings by FRANK HUBBARD



1 AN IMMIGRANT BOY, Eric Gunnar Gibson came to America from Sweden with his father, mother, and younger brother when he was six years old. After graduating from Senn High School in Chicago, he went to work as a butcher. Enlisting in the Army, he was called to duty in 1941.



4 BEFORE ANZIO, Gibson went to his company commander and asked to be allowed to land as a rifleman.



5 LEADING A SQUAD assigned to clear Germans out of a ditch, Gibson poked his submachine gun into a clump of bushes and let go, killing his first Nazi.

7 NEXT, a heavy machine gun opened up from 200 yards away. Telling his men to lay down a covering fire, Gibson crawled through a hail of bullets. At 35 yards, he threw two hand grenades, then ran forward with gun blazing. His panting followers found two dead Nazis, one prisoner.



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2 "BEST COOK IN THE ARMY" was the way Eric's buddies described him. He took pride in his work, but at heart he was a fighting man.



3 TORPEDOED during the first landing in Africa, he swam ashore from his transport rather than wait for a boat.

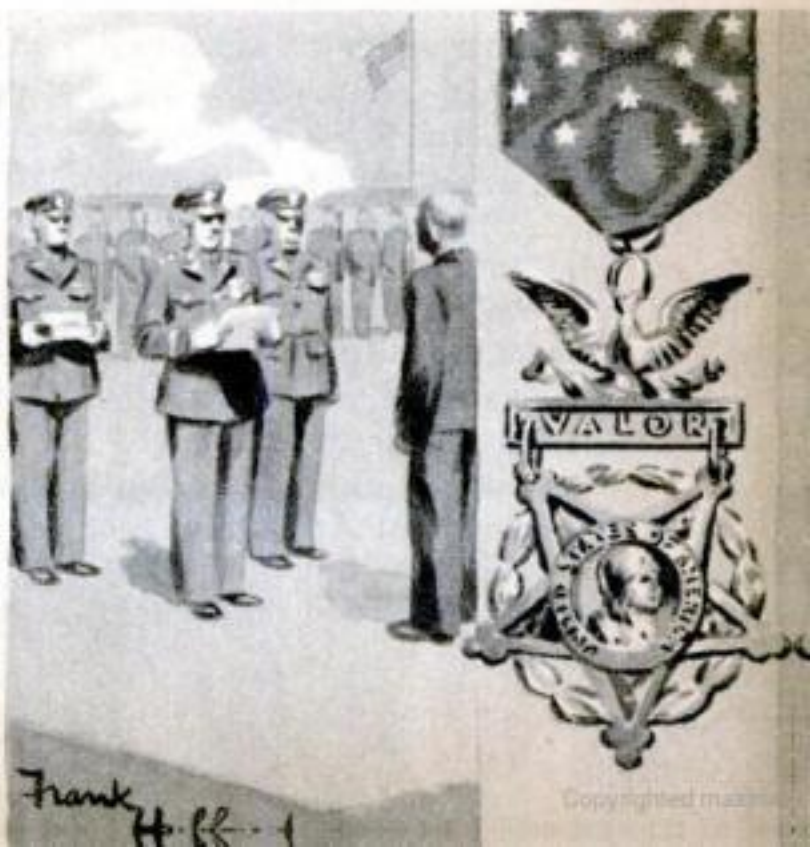


6 MOVING ON, the squad came under fire from a machine pistol and a rifle. Again leaving his squad behind, Gibson ran 75 yards up the bank and fired into another pile of brush. When the squad caught up this time, one German lay dead and another came out with his hands up.

8 ONCE MORE, Gibson went ahead to reconnoiter. His men heard a machine pistol let go, then the submachine gun. They found Gibson dead beside the German.

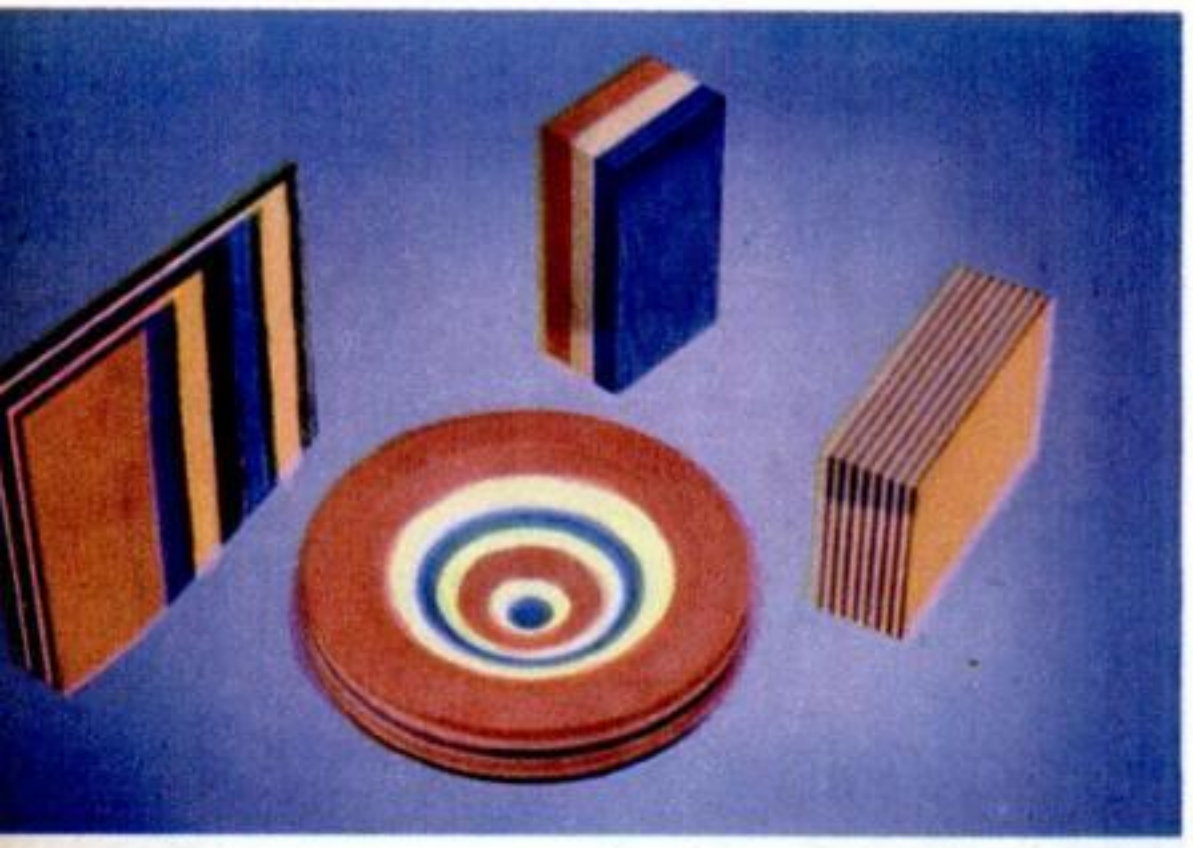


9 "FOR VALOR." To Eric's proud father went his Congressional Medal of Honor, posthumously awarded.



YOU ARE REALLY GOING TO LIVE WITH AND IN PLASTICS

INTENSIFIED WAR TIME RESEARCH FINDS NEW SYNTHETIC MATERIALS AND DISCOVERS MANY MORE USES FOR THE ONES WE HAD ALREADY.





Arboneeld wood (upper left) is ordinary wood impregnated and colored with methylolurea. These samples are designed to show how plastic and color go through material. The process makes hardwood out of ordinary softwood. Above is a woman's heel similarly treated to toughen the wood and give it permanent color



This pipe is made of a common hardwood treated in the same manner by the Du Pont Arboneeld process. The separate bit shows untreated wood

By GOLD V. SANDERS

YOU will never imagine what plastics are going to mean in your postwar life so long as you think in terms of ash trays, women's compacts, pipestems, and electric plugs. For the really interesting wartime developments have been in quite different directions. To get more on the beam, think rather of fine lingerie, men's suits superior to anything ever seen before, fabrics of beautiful color and texture. Think also of new kinds of furniture, wall panels, floor tile; of shoe soles that are more flexible and wear twice as long as leather. Consider a new kind of wood, plastic-treated, with a hard and permanent finish going all the way through it.

These are only a few random suggestions of what lies in store for everybody, thanks to a few years of intensified research in Government and manufacturers' laboratories.

The newest achievement of the molecule jugglers is an entirely new plastic—polyethylene, also called polythene for short. So vitally important and useful is it in wartime applications that it has been kept a secret for two years. In peacetime it will have equally important uses. Everybody will find it serviceable in one way or another.

Polyethylene belongs to the class of

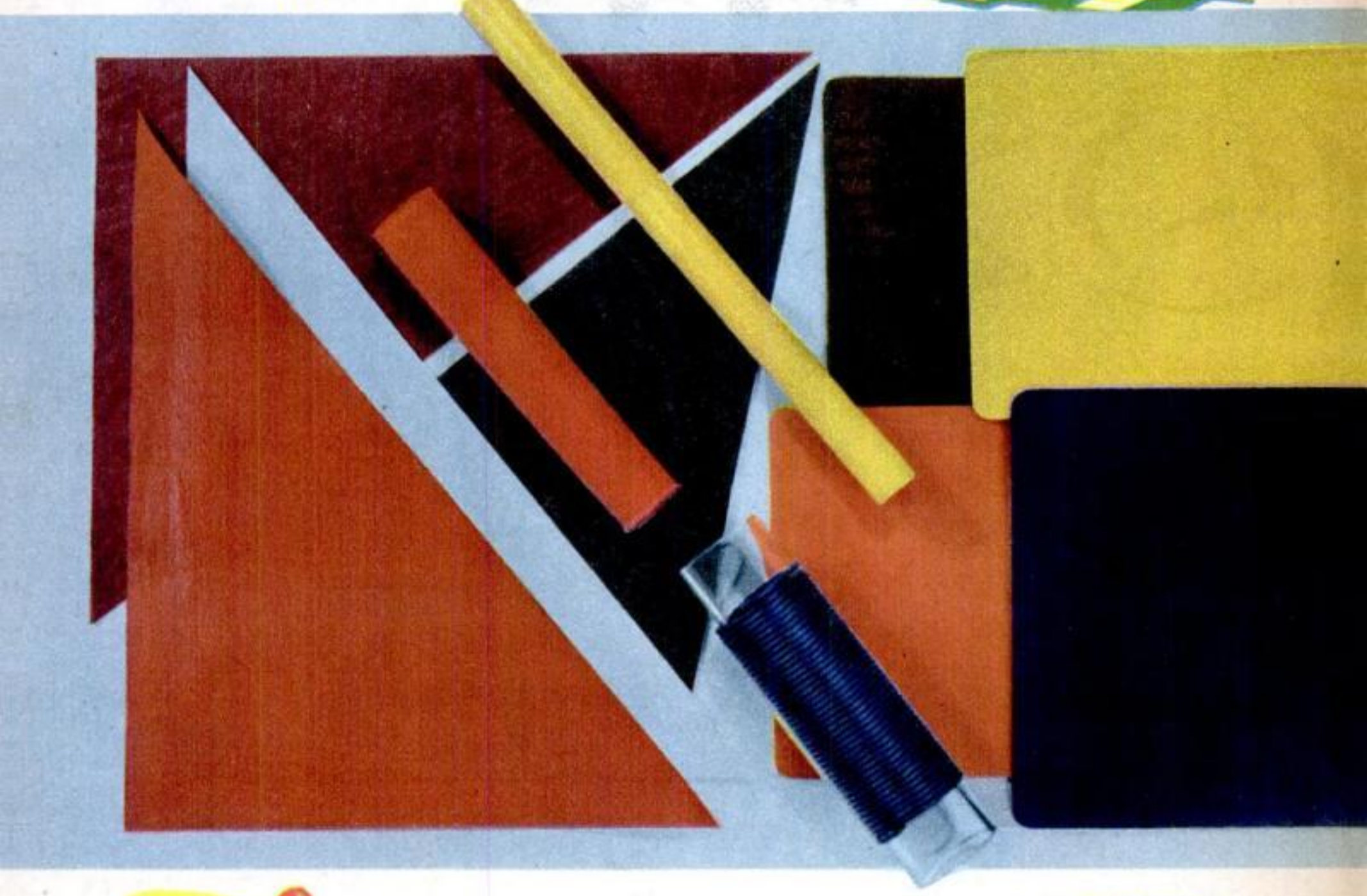
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PIPING. Polyethylene, because of flexibility and resistance to corrosion, may rival metal piping

TILING, either floor or wall, made from this plastic withstands shock







UPHOLSTERING. New leatherlike coverings for furniture can be made of polyethylene plastic

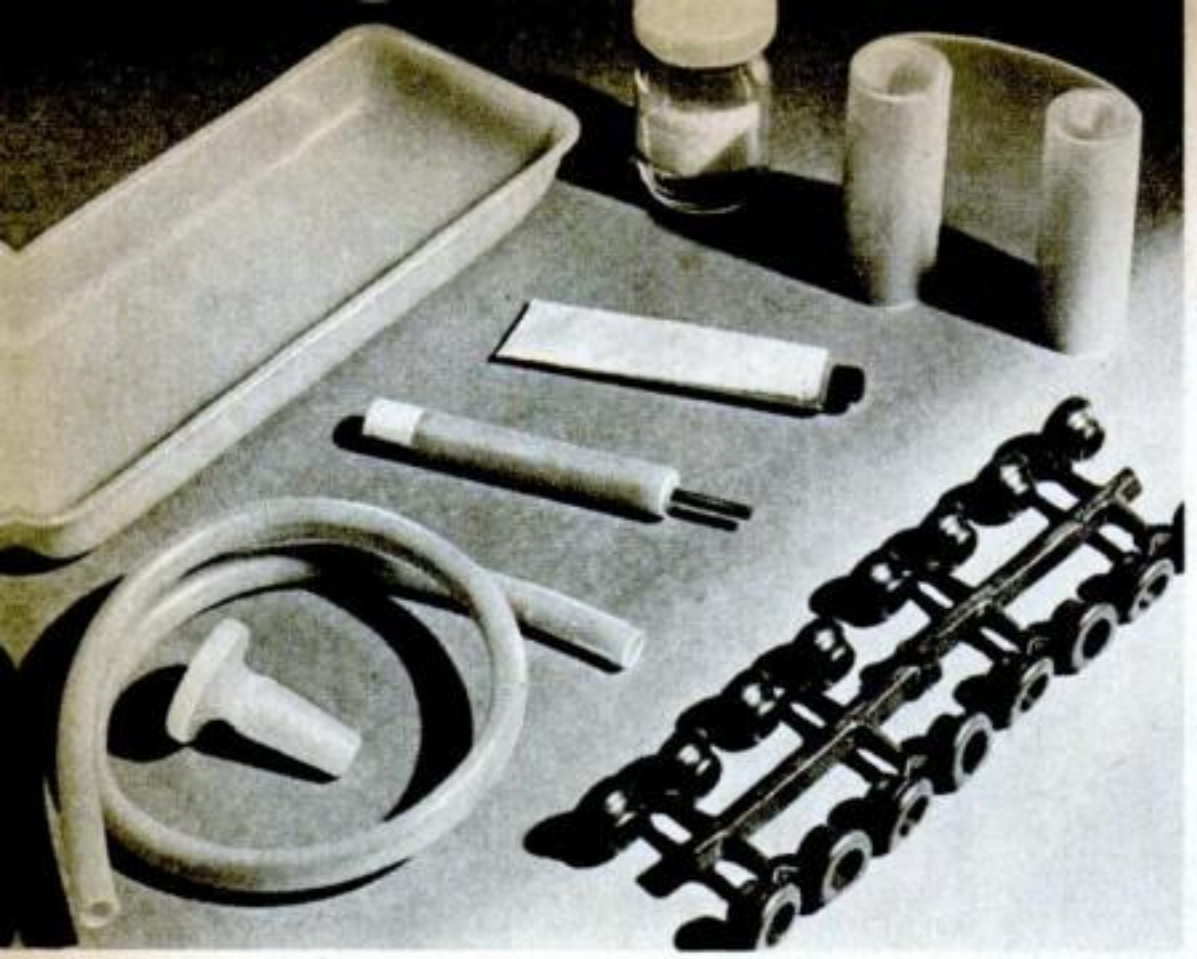
INSULATING with this plastic has already been tested by fighting forces. Various colors help identification of the circuits



THE COLORFUL ARTICLES shown (above center) are made or treated with a plastic called polyethylene, the use of which is at present restricted to vital insulation in radio sets and other high-frequency war equipment. Sketches at the four corners of the grouped articles indicate a few of the many postwar uses to which they will probably be put



Plastic upholstery cloth (right) woven of Saran, a vinyl resin. The finer fibers go into draperies; the coarser, into screens



Adaptability of polyethylene is demonstrated by these articles. Grommets were injection-molded in one shot



Nine months' immersion in brine didn't affect this iron rod sprayed with plastic

thermoplastics, those that can be softened by heat. It is in this field that the greatest advancements have occurred during the war years. These are the plastics that are somewhat flexible as contrasted with the thermosetting class, which generally are hard and brittle.

It is the thermoplastics that lend themselves so admirably to the weaving of fabrics or the improvement of other woven textiles. Cloth of any texture, coarse or fine, can be made from thermoplastic filaments or spun fibers. Cotton or wool yarn can be coated or impregnated with the plastic resins with remarkable results. A prominent research director has promised for the postwar period, among other wonderful things, men's wool suits, plastic treated, that will not wrinkle even when wet and will wear about three times as long as untreated wool. The fabric will have the same feel and texture as if untreated (P.S.M., Sept. '44, p. 79). He also predicts women's fine stockings that will not run. Every woman looks forward to the day when she can have her precious nylons again, but few realize that postwar nylons will be finer and better and that there will be other similar new plastics.

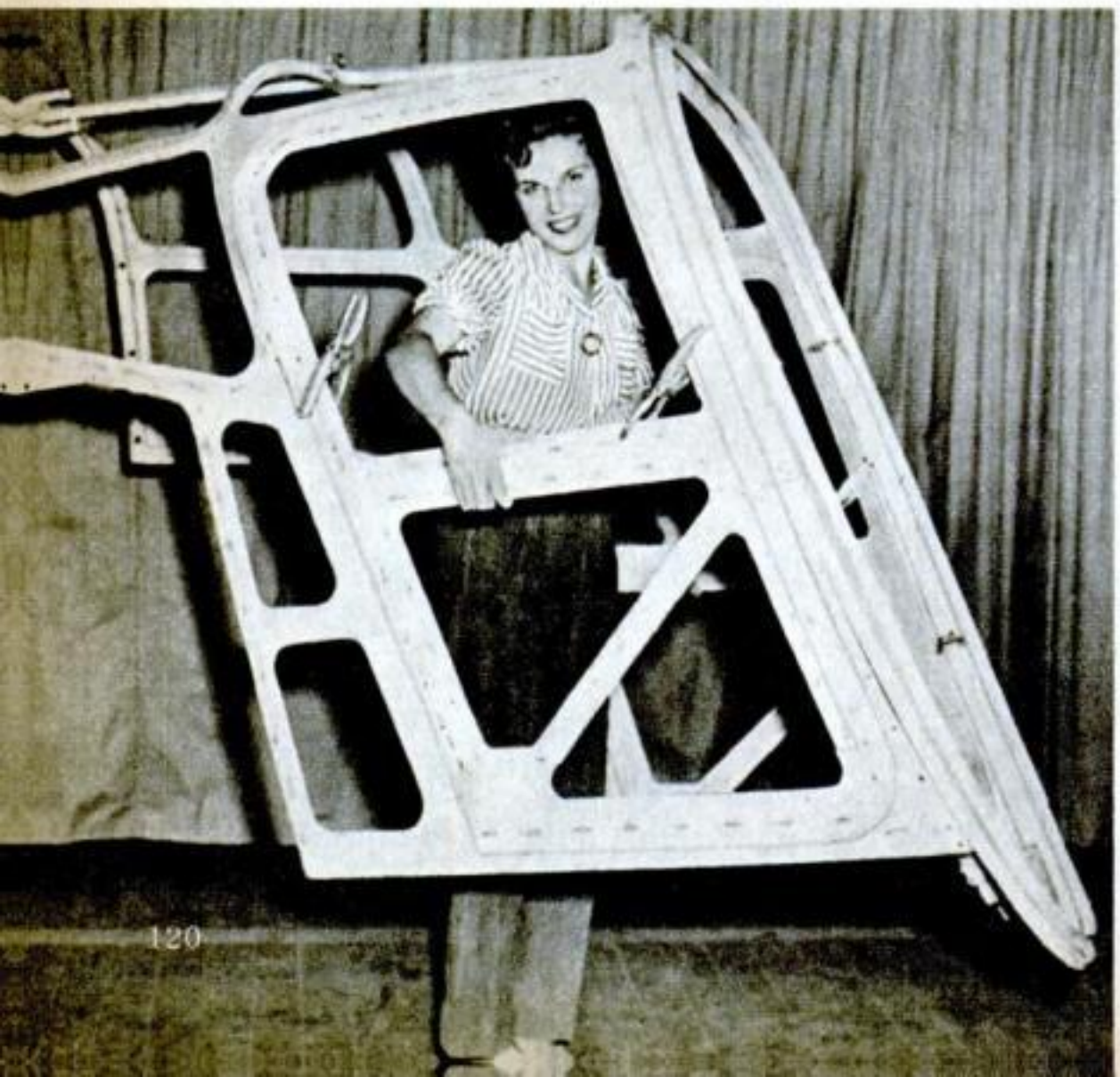
Polyethylene is produced by Bakelite and

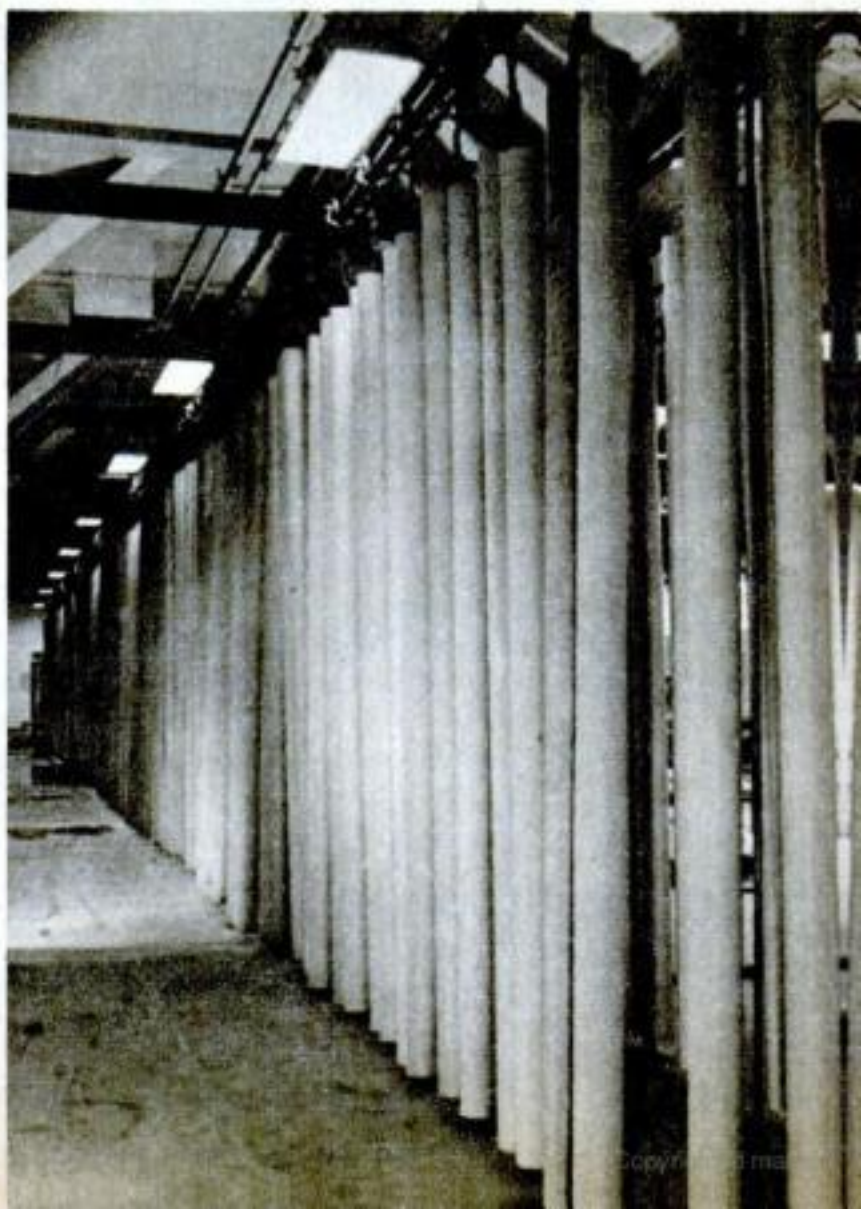
U. S. Rubber Co.

This cabin structure of the new war helicopter R-6 is made of Fiberglas laminated with thermosetting plastic

General Electric

Rocket projectors for Thunderbolts are made of paper bonded by synthetic resin





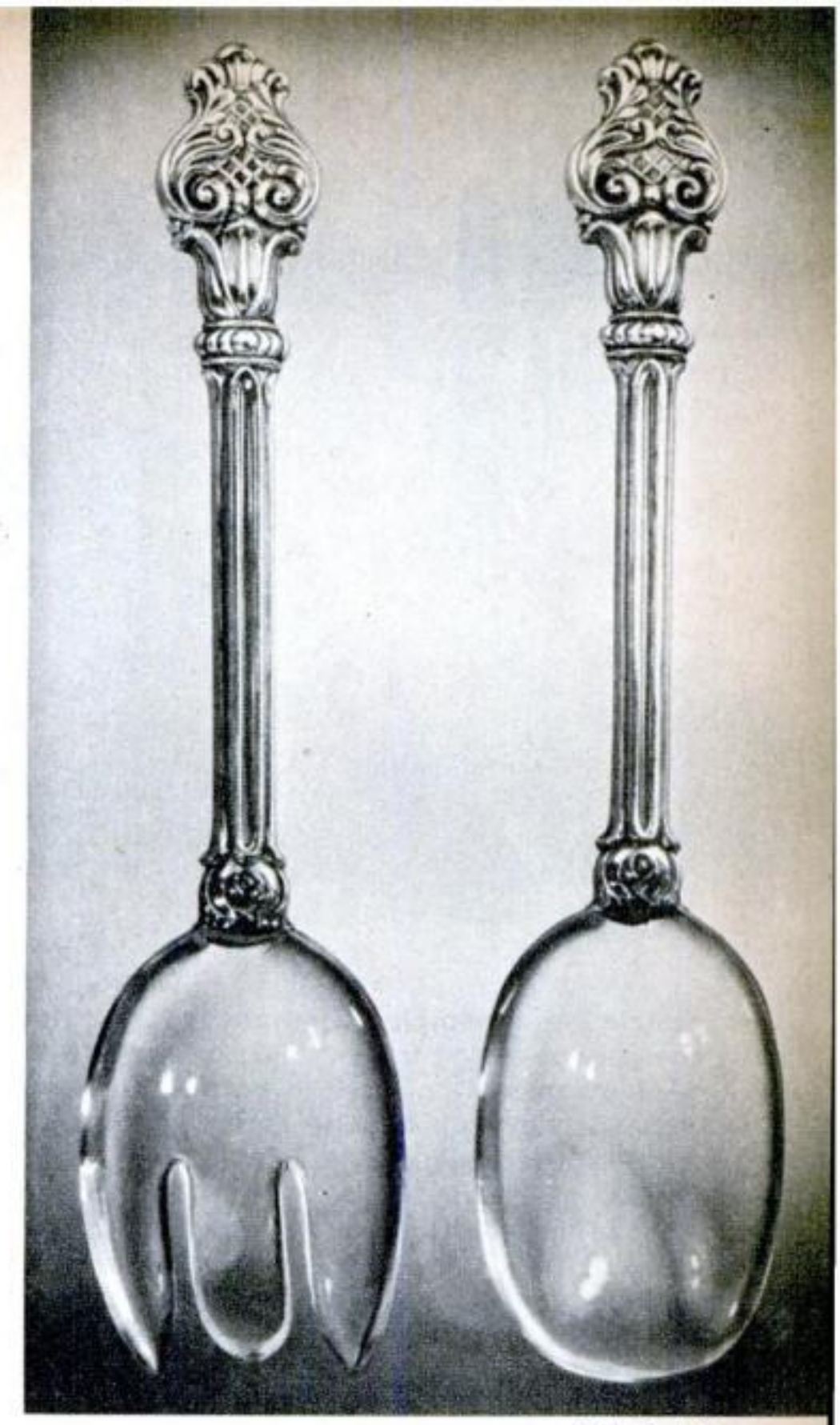
by Du Pont. The amount now being turned out is large, but it has been commandeered 100 percent for military use. Because of the peculiar arrangement of its molecules, it is the best insulating material yet found for high-frequency current. Also, it can stand heat up to 230 degrees Fahrenheit. There was no thermoplastic before the war that could stand boiling temperature. Now there are several, including Monsanto's Cerex and Styramic HT. This development means that these otherwise desirable materials can now be used in many applications from which they formerly were barred.

Another extremely important property of polyethylene is its unique resistance to acids, alkalies, sunlight, oxidation, oil, and gasoline, all of which destroy rubber. The new plastic thus has some of the best properties of both rubber and plastics without corresponding deficiencies. It is also extremely tough. An article molded from it can hardly be damaged at all by pounding it vigorously with a hammer. It certainly will not break from being dropped on the bathroom floor, like things made from the hard and brittle plastics. It can be compounded to be soft or rigid, but even in its hardest state it has some resilience.

What will be the everyday uses of such a versatile plastic when its war work is done? The manufacturers themselves have been too busy to determine that fully. Knowing its many excellent qualities, they are sure it will continue to find wide use as insulation for radio, television, and other high-frequency equipment. In the textile field it will be among the best mediums for coating and impregnating thread and yarn as well as finished fabrics. The fine filaments can be woven into many grades of textiles, giving them all the remarkable properties that the resin itself possesses. Manufacturers also predict its use for floor tiles, washable wallpaper, auto hardware, steering wheels, hammer heads, typewriter keys, and many other moldable articles.

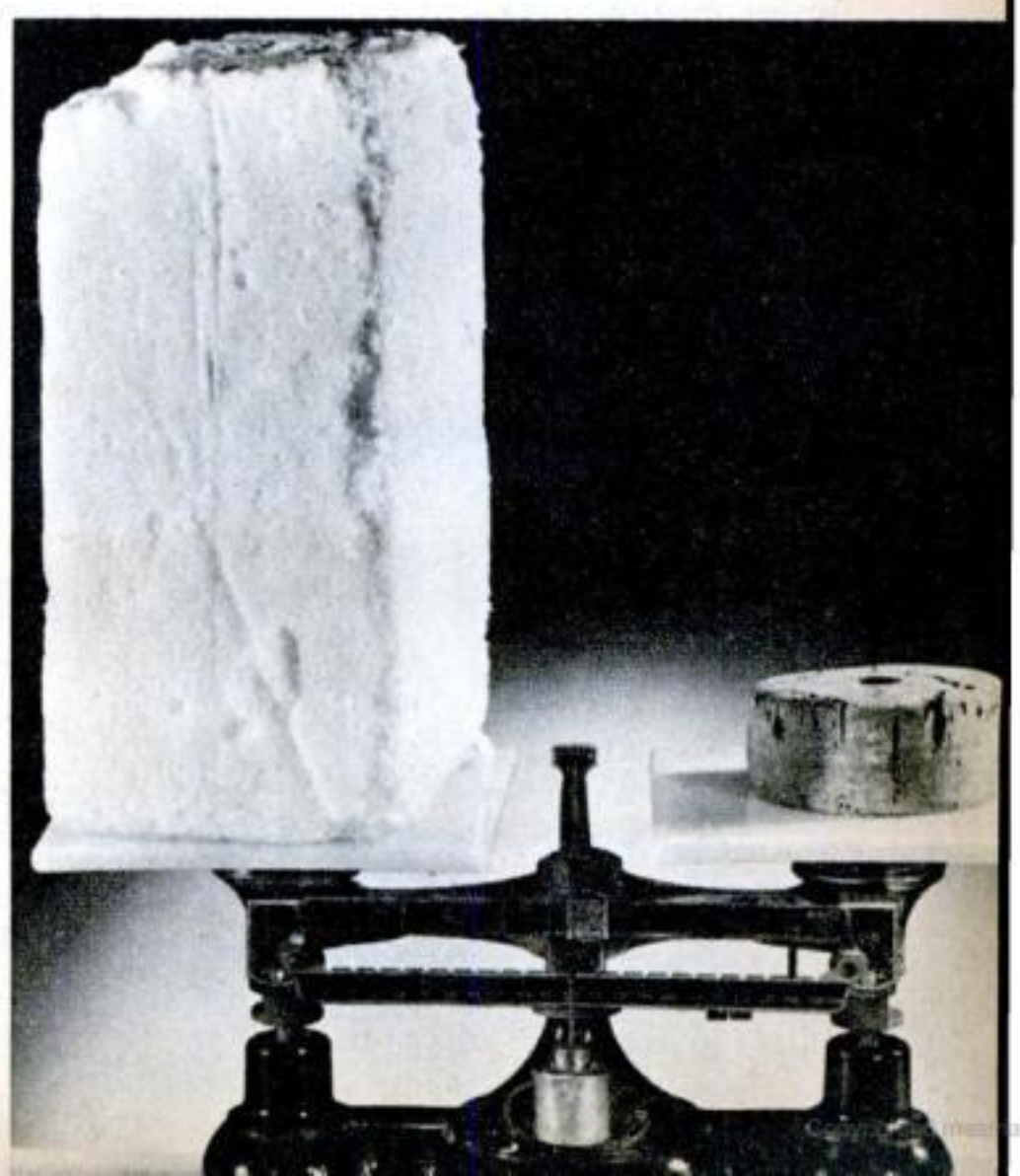
The natural resin is clear and so can be dyed any color. It is produced from ethylene, which is derived from coal or petroleum. Ethylene is subjected to 1,500 atmospheres of pressure and extremely high heat. This drastic treatment converts it into an entirely new compound by rearranging the molecules — polymerization, the chemists call it.

While polyethylene is an entirely new plastic and its creation a brilliant achievement, the plastics researchers have achieved equally remarkable things during wartime in the improvement of existing plastics and in devising new uses for them. This list is far too long to attempt to cover in this



Metaplast Corp.

Lucite salad set with silver-plated handles. Buoyant plastic foam below weighs one seventh as much as cork



U. S. Rubber Co.





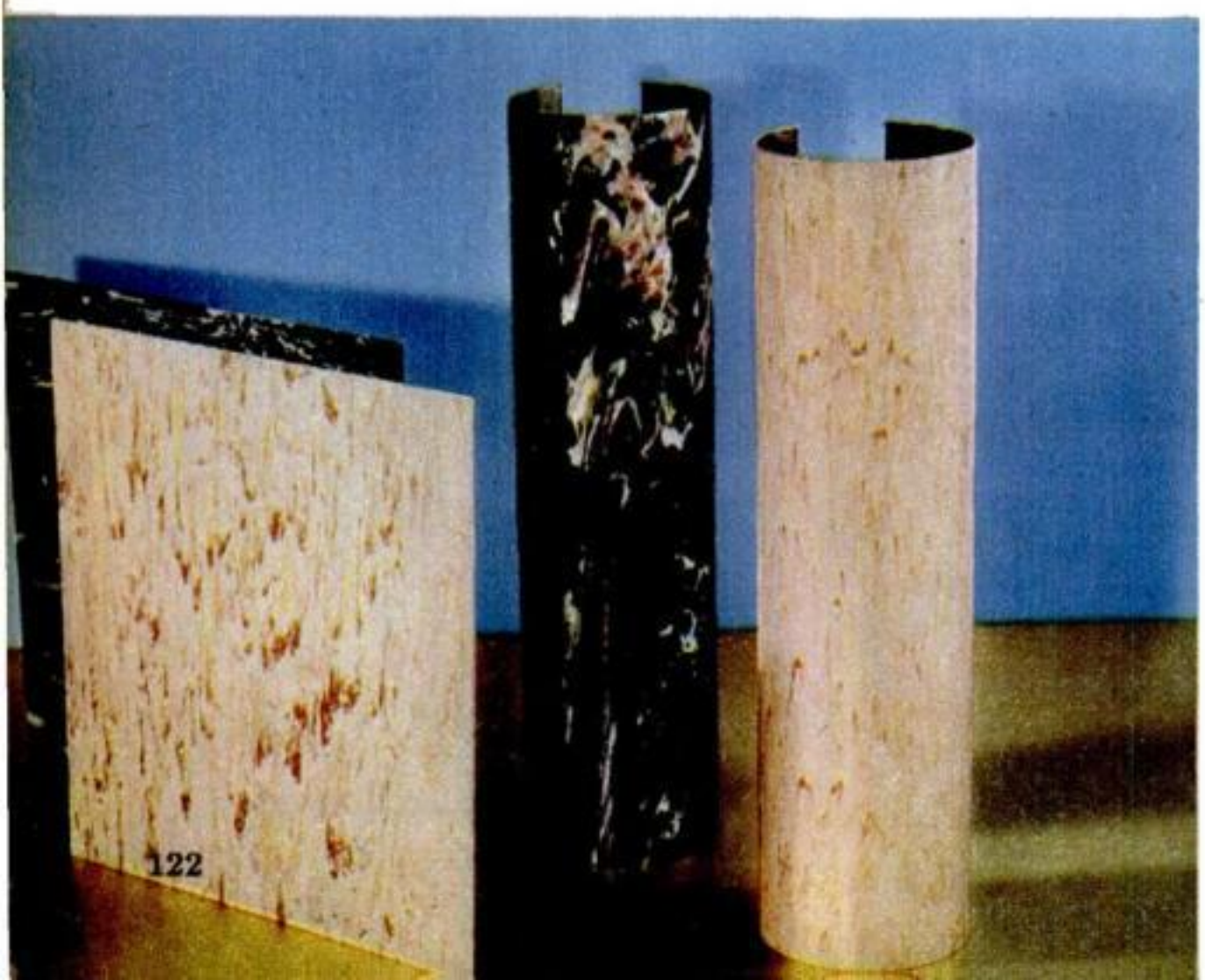
Improved plastic cabinets for postwar radios are on the way. This one is of ethyl cellulose

Dow Chemical Co.

High chemical resistance makes these Styron plastic bottle closures especially suitable for use on reagent bottles and carboys for corrosive liquids

article. As a sample, we might mention the recently revealed use of plastic barrels for rocket launchers on fighter planes. There is a plastic that can hold up under such treatment as that, though its composition is not yet being told. The barrels are made of layers of tough paper, impregnated and bonded with a plastic material. Thousands of them are in use on fighter planes where their light weight is of vital importance. A fighter carries as many as six of these. The fiery blast of the rocket projectile does not hurt them. Such a plastic surely will have almost limitless uses, replacing metal or wood.

Wood itself is going to be an entirely different material when treated with a plastic substance such as methylolurea, recently announced by Du Pont. By impregnation with this chemical, ordinary softwoods can be made as hard as hardwoods, and hardwoods can be made even harder. At the same time, the wood can be given any color desired, all the way through. The fine cells of the wood become saturated with the resin, which hardens and thus converts the entire wood structure into something that is nearer to a plastic than to wood. Wood thus treated will not warp, crack, swell, or rot. It is believed that termites and other insects will not attack it. By this treatment, many cheap softwoods, now considered of little value, can be converted into desirable lumber for many purposes where only hard-



Imitation marble made of plastic. When a thin sheet is permanently glued to metal with Pliobond, a synthetic-resin adhesive, the combination sheet can be bent, sheared, and even welded to other metal without impairing permanency of bond

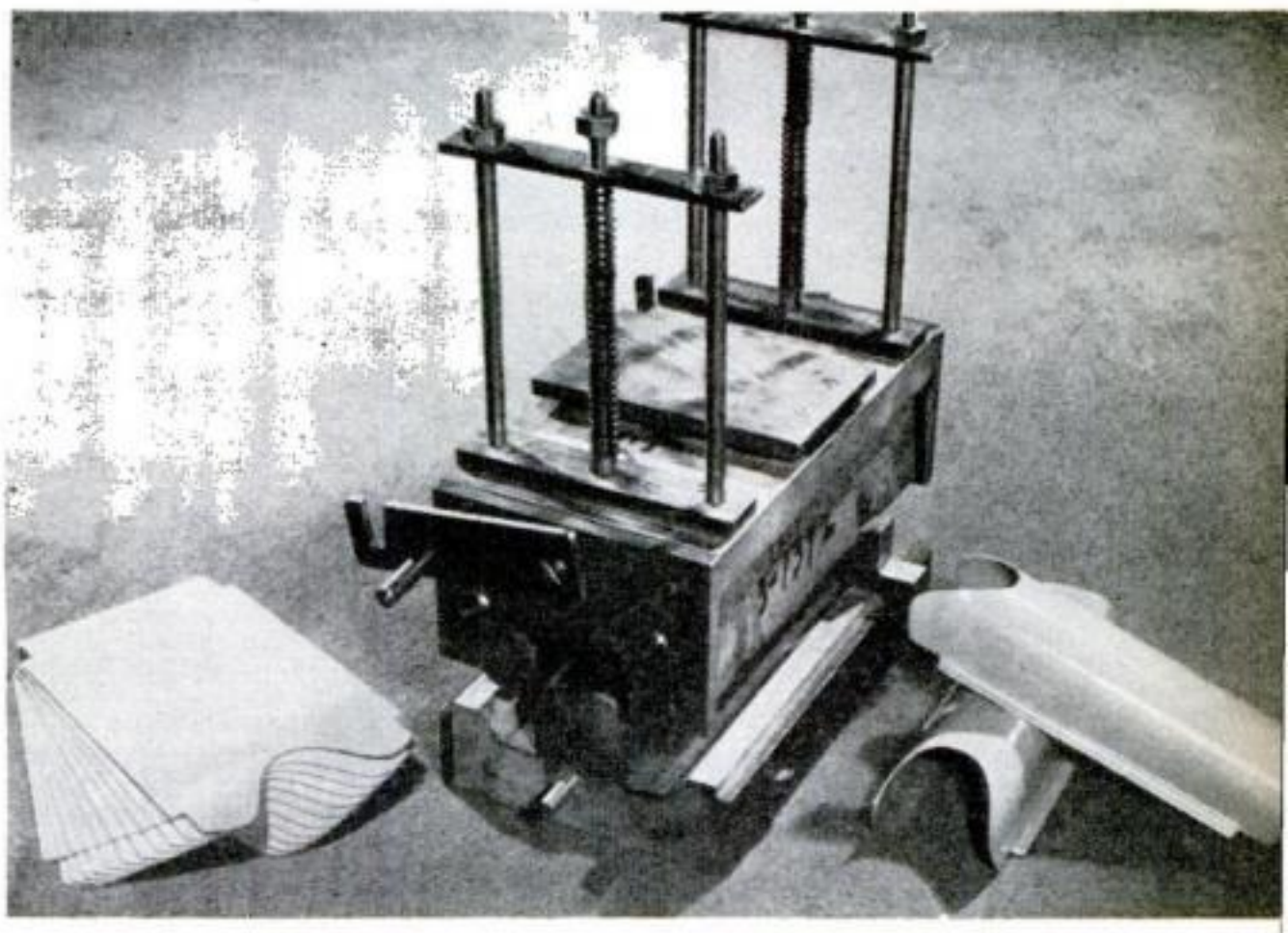
Goodyear

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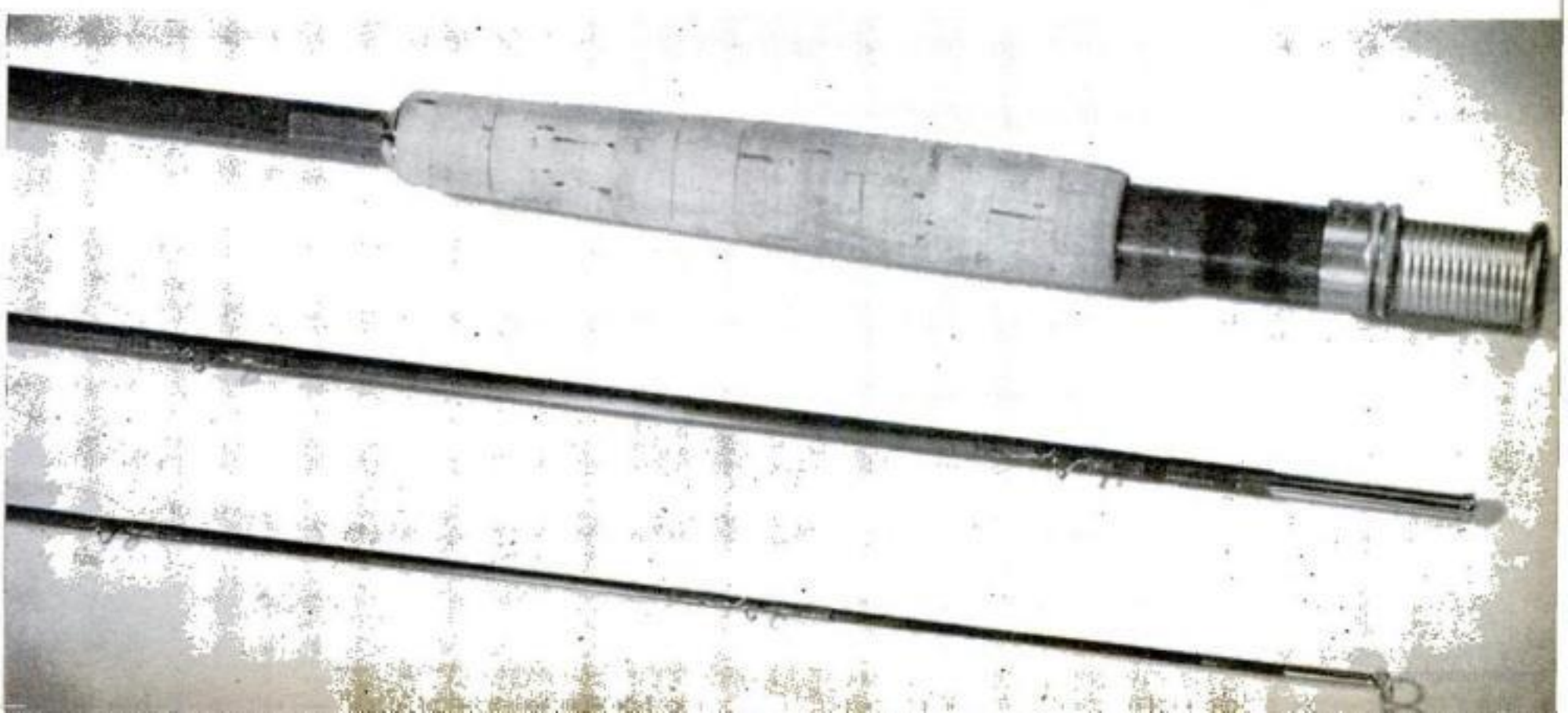
woods were considered suitable before. One of the most general uses is expected to be in the making of furniture from common softwoods, that will have the finish, strength, and all-around usefulness of the more expensive hardwoods. It is also considered especially useful in flooring because of its durability and the fact that the wood is the same all the way through. If the surface is scratched, it can be restored by sanding, the repaired part retaining the same finish and color as the rest. Any desired color can be obtained by incorporating the dye in the liquid resin. Du Pont has given the name Arboneeld to wood treated in this way.

Impregnation of wood with synthetic resins has contributed in many ways to the fabrication of war equipment. Various resins have been used with great success, notably phenolic compounds, which are the most resistant to water. The methylolurea developed by Du Pont is considered to be the most generally useful and practical. Its cost is low enough to give it widespread application, and can be made even lower if the wood is treated only to a given depth—case-hardened, so to speak. In this form, the method may be practicable for treating light poles and structural timbers. In any event, this is a development of enormous importance in a wide range of wood uses. Its value will be enhanced by combination with genuinely waterproof resin glues, also produced by the plastics industry (P.S.M., Nov. '44, p. 74).

There is yet another highly promising field for new development in plastics—that of the silicones. Here the chemists have produced some remarkable new compounds by a combination of organic resins with silicon, derived from sand and minerals—the stuff from which glass is made. Research and experimentation directed toward such a marriage had been carried on for decades, and *(Continued on page 209)*



This simple wooden press replaces expensive machinery in a new plastic-forming process developed by the Formica Insulation Company. Blanks of laminated material (at left) are heated and placed in the press to shape articles as at right



Bamboo fly rod impregnated and glued with phenolic resin is impervious to water, has a satin finish, and never needs varnishing. It has an additional resistance to the fixed curve that fishing rods are apt to develop

Are Spiders Our Friends?

YES, SAYS DR. PETRUNKEVITCH, WHO HAS BEEN STUDYING THEIR STRANGE HABITS FOR 67 YEARS



Dr. Alexander Petrunkevitch, leading authority on spiders, displays his pet Mexican tarantula, which has lived in his laboratory seven years. He feeds her cockroaches raised for the purpose, a roach a week. See close-up on opposite page

Photos by Robert F. Smith

By GOLD V. SANDERS

THE MAN who knows more about spiders than anyone else in the world calmly picked up an immense, hairy tarantula and held it in his hand while we took his picture.

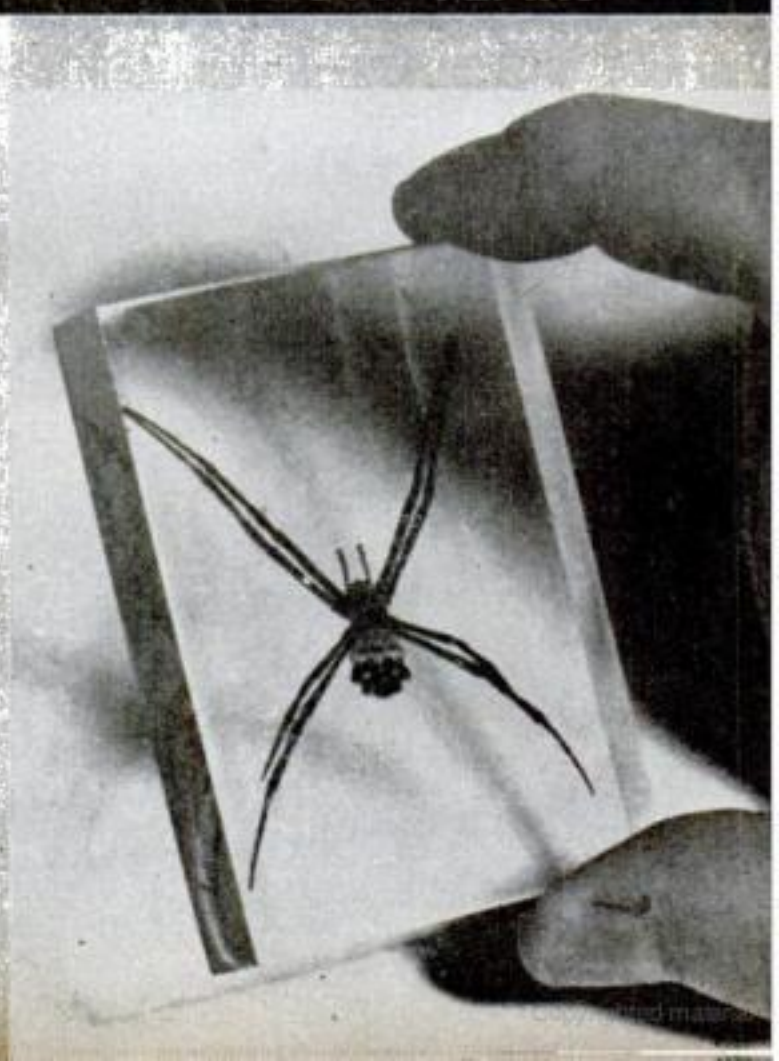
This was Dr. Alexander Petrunkevitch, whose writings on spiders fill many shelves in the libraries of the world. "Our friends, the spiders," he calls them, and he knows whereof he speaks—knows it from 67 years of close acquaintance with them, starting when he was a two-year-old, in Russia. The great scientist has just retired as professor of zoology at Yale, but he is not giving up his lifelong association with the spiders and their relatives. He looks forward with eagerness to many more years of watching

THEY HAVEN'T CHANGED MUCH IN THIRTY MILLION YEARS



A 30-million-year-old spider preserved in amber. From such specimens Dr. Petrunkevitch discovered that no great evolutionary changes in spiders have occurred in this time. He identified families that still live

Photo from A. Petrunkevitch



The doctor does a better job with synthetic resin than nature does with amber. Thus preserved in a substance clearer than glass, specimens (right) may be examined with microscope

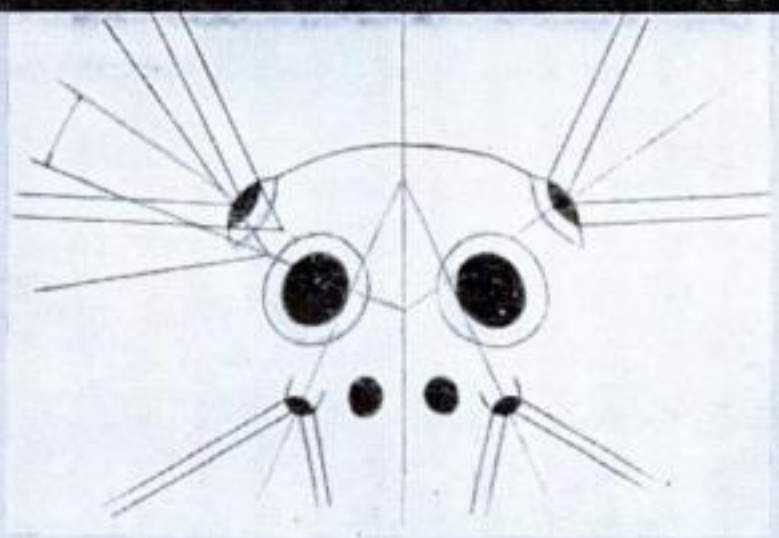
Photo by Robert F. Smith



them in the woods and fields and the opportunity to contribute more to the already immense amount of knowledge he has given us on the subject.

It was Petrunkevitch who definitely established the facts about the strange, indirect mating methods of tarantulas, employed by all spiders, one of the oddest phenomena in nature. This took patience and years of sharp observation. Then he went back 30,000,000 years and examined remains of spiders preserved in amber to see if he could find evidence of evolutionary steps by which this odd technique was acquired. The London Museum lent him its priceless collection of fossil spiders for this research. By microscopic study, he determined that the male spider, then, as now, used his palpi,

A SPIDER SEES THE WORLD THROUGH FOUR KINDS OF EYES



Not even Petrunkevitch, whose diagram drawing is shown above, knows why spiders have four pairs of eyes, each pair with a different size of image and angle of vision. At right is close-up of a banana spider showing half of his quadruple equipment. Different species of spiders have their eyes in various locations

Photo by Lee Passmore



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DUEL TO THE DEATH: WASP vs. SPIDER



The beginning of a finish fight—no holds barred—between a tarantula and his deadly enemy, the wasp. The insect seems to hypnotize or terrorize the spider



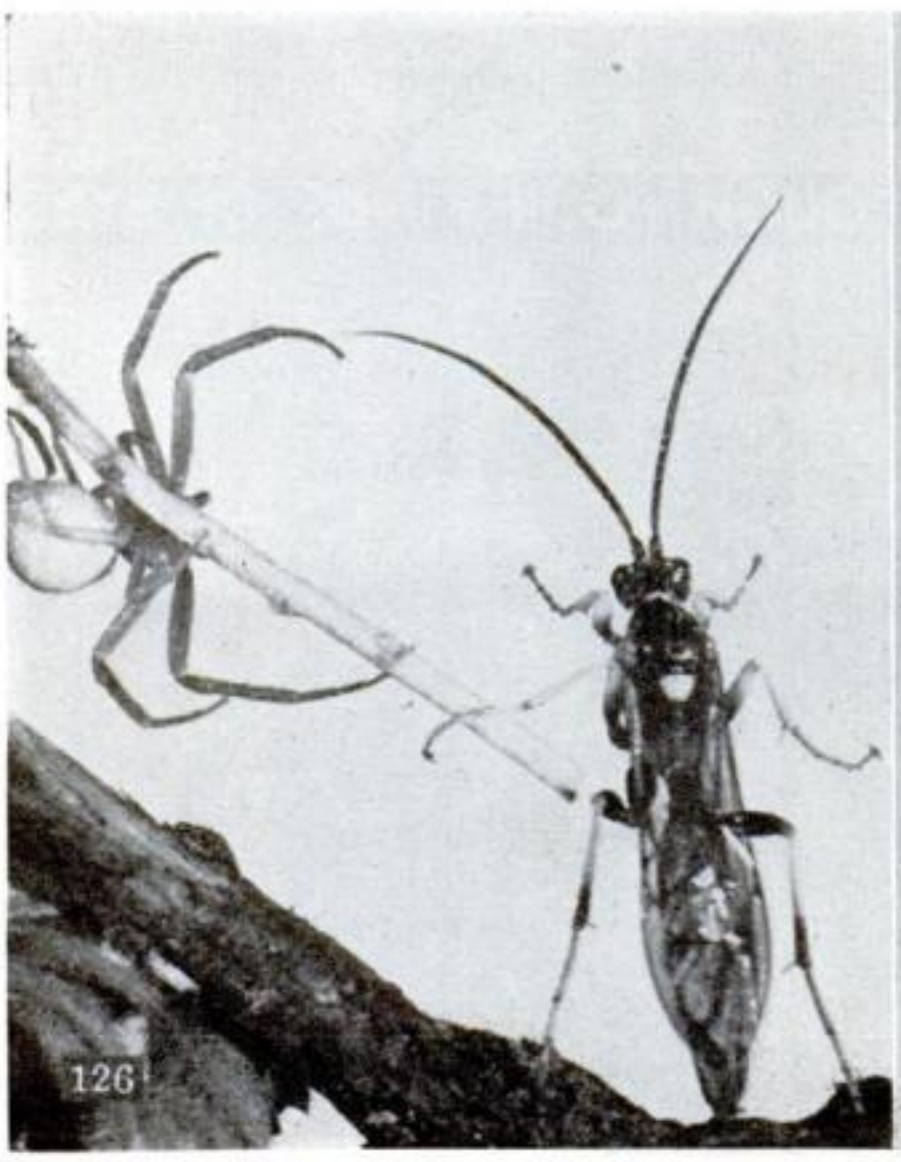
Wasp seizes the tarantula by one foot and throws him on his back; inserts his vicious stinger into a soft spot at the base of leg

Photos by Lee Passmore

or feelers, as auxiliary propagating instruments. In the female they were only feelers, then as now. Obviously, this evolutionary step had been taken even farther back in prehistoric time.

It was Petrunkevitch who made the astonishing discovery that spiders see four different images at once, all of different sizes. The purpose of this he cannot imagine, but it is doubtless among the riddles he will keep on trying to solve through expert observation and microscopic study. His improvements in photomicrography, incidentally, are among his many contributions to science, and his techniques are widely used by workers in many fields.

The reason why Dr. Petrunkevitch can pick up a tarantula with impunity is that he knows which kinds to pick up and which to let alone. In all his years of handling spiders he has never once been bitten, which itself is pretty good evidence of his knowledge. He has observed them and photographed them in Europe, the United States, the West Indies, Panama, and Mexico. He has had as many as 210 tarantulas in captivity at one time, not counting several scorpions, black widows, and other spiders. The tarantulas living in this country are quite docile and will not bite except in self-



CRAB SPIDER (left), reversing the above procedure, kills a wasp much bigger than itself. It creeps up near its victim so carefully that it is undetected until it makes the final leap

BLACK WIDOW is commonly believed to make a meal of its tiny mate after the honeymoon, but the doctor has seen 13 males living peacefully in the same web at once with the female

Photos by George Elwood Jenks



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Poison puts the tarantula in a coma without killing it. Here the wasp takes a look at the paralyzed spider after injecting the dope



Wasp drags anesthetized tarantula into burrow where an egg will be laid on its body and the hole sealed up, insuring a supply of fresh meat for the wasp larva

defense. There is one mean scoundrel from Haiti that he will not pick up; it strikes at anything that comes near it. A tarantula bite, the doctor says, is not at all serious.

Years of observation have only increased the learned doctor's wonder at the marvelous things spiders do through pure instinct. Take, for instance, a baby spider, no bigger than a pinhead. When it is a few days old, it leaves its native haunts, riding high on a long strand of web that it spins for the purpose. Maybe it comes to earth a hundred miles away, then goes into hibernation until spring. Then, never having seen anything of the kind done before, it proceeds to build a perfect web, measuring accurately the distance between strands, waits for food to drop into it, and knows how to wrap up and tie its victims. Suppose this is a female, sitting in her nest, waiting for her prey, springing out to devour it, be it insect, spider, or anything else edible. Along comes a male of her species. He touches a strand of the web with his foot and tugs gently at it. She does not attempt to eat him, but answers his messages by answering taps on the web. The telegraphic system goes on until the male is assured it is safe to enter.

Another variety of male spider uses quite a different court- *(Continued on page 209)*

TRAP-DOOR SPIDER (right) lifts the perfectly fitted, camouflaged lid of her burrow to seize a bug and drag it home for dinner. The smooth wall of the nest is neatly lined with web
Photo by Lee Passmore

NIGHT HUNTER. For stalking his prey and leaping on it in the darkness, the jumping spider is specially equipped with night-vision eyes, the largest of his four pairs of lookers
Photo by George Elwood Jenks





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Nineteen U. S. Inventions That Changed the World

PART I

YANKEE GENIUS has improved the lot of the whole human family and altered the course of history. We asked Miles Henninger, patent lawyer and close student of American invention, to name the U. S. patents that he considers most momentous in world progress. Eight of his choices are described here, and 11 more will be covered in a later installment. Mr. Henninger is associated with the law firm of Lecher, Michael, Spohn & Best, of Milwaukee, Wis. His selection is based on material collected for an article in the *Allis-Chalmers Electrical Review*.

1. THE GRAIN HARVESTER 1834



CYRUS McCORMICK perfected the reaper after his father abandoned experiments begun in 1816. McCormick had a grade-school education plus experience on his father's farm and in his father's sawmill, grist mill, and blacksmith shop. When the father dropped its development, the reaper had a reel for pressing grain against rotating knives; the cut grain fell on a platform from which it had to be raked by hand and then bound. McCormick made the cutter as a bar with sawlike teeth reciprocating in wire guards, and added a divider for separating the swath to be cut from the standing grain.

Since the small eastern farms could not afford a machine costing even $50, McCormick went to the midwest with its large and level grain fields. Chicago was selected as the factory site, and business was begun with $25,000 invested by the then Mayor William Ogden. The first year 500 reapers were sold, and 1,500 in the year following, when McCormick bought back Ogden's half share for $50,000. In 1851 he received the Grand Council medal at the London World's Fair because his machine was "worth the whole cost of the exposition" to the people of England. McCormick was honored as "having done more for agriculture than any other living man," and a probate of his estate in 1884 showed that he had accumulated a fortune of $10,000,000.

2. THE COTTON GIN 1794



ELI WHITNEY was the son of a farmer at Westboro, Mass. In his father's repair shop he showed mechanical aptitude by hand-forging cutlery, nails, and ladies' hatpins during the Revolution. He was educated in arts (Yale 1792), and went to Savannah, Ga., as a tutor.

The problem of removing seeds from cotton faster than the prevailing rate of four pounds per day per worker challenged Whitney, and late in 1793 he produced a device including a hopper with spaced side bars and a rotating cylinder with teeth passing between the bars to pull out the cotton fibers while combing back the seeds. A rotating brush removed the cotton from the cylinder teeth. The cotton gin was so successful that everyone talked about it; the first model was stolen, and soon gins were being made by clever handy men. Whitney's invention was the means of increasing the annual cotton crop from the 200,000 bales of 1791 to the 15,000,000 bales of today, and is the primary cause of cheap cotton cloth. A total of $90,000 was collected in royalties, but so much was spent for prosecuting infringements of his patents that the inventor had little left. By then, the market for gins was saturated, but Whitney made 100,000 muskets for the War Department by using special machine tools to make single interchangeable parts, thus introducing mass production.

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3. THE SEWING MACHINE 1846

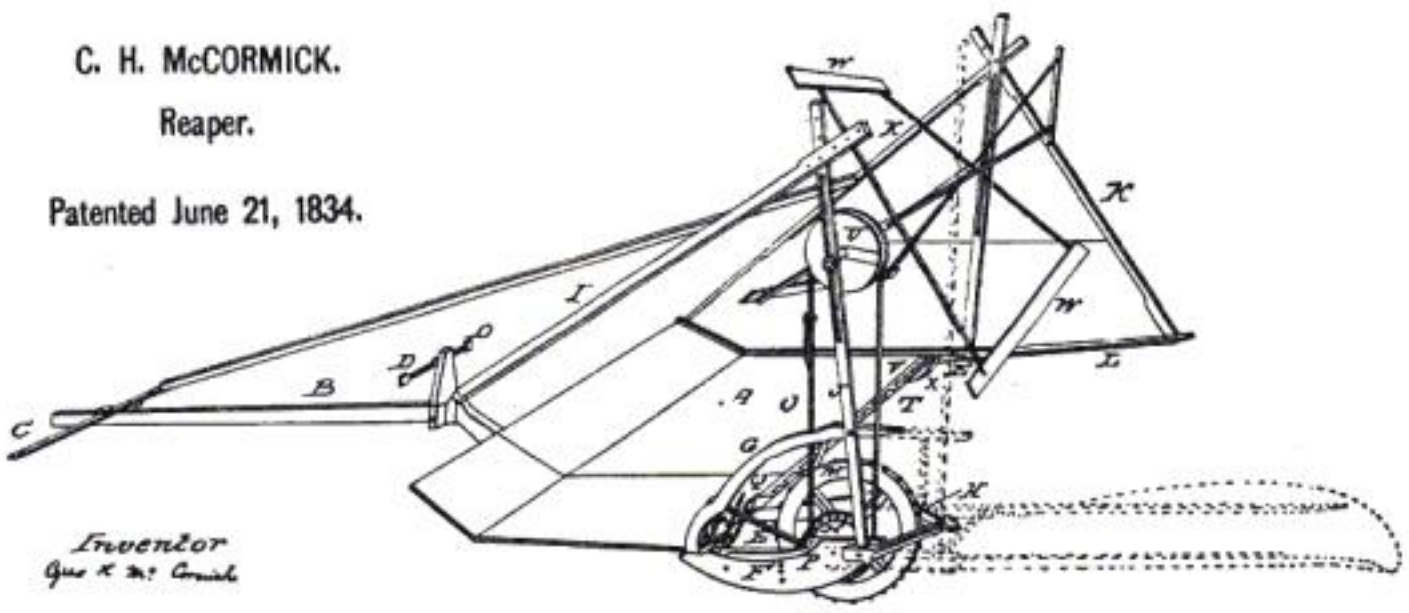


ELIAS HOWE was born in 1819 on a Spencer, Mass., farm where the equipment included a grist mill, a sawmill, and a shingle machine. Howe, handicapped by lameness, was apprenticed to a neighbor when 11 years old. At 16 he went to the Lowell mills and then to Davis' instrument and watch-repair shop in Cambridge. Here he got the idea that a machine for sewing cloth was needed and would be profitable.

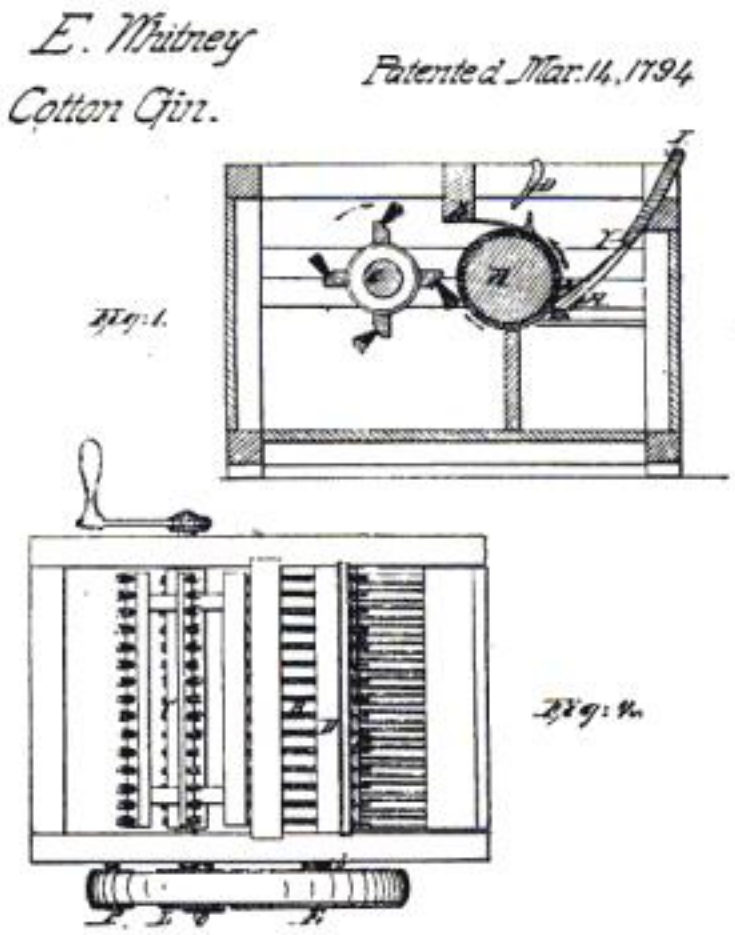
Years of work preceded the conception of two eye-pointed needles for making interlocking loops, replacement of one needle by a shuttle, the need for a thread tensioner, and a cloth-holding and tensioning foot. Contests with the fastest seamstresses of the time showed that the machine sewed faster and made better seams, but still no sales were made. Attempts to exploit the machine in England failed and resulted only in hardship to the inventor and his family. Isaac M. Singer saw the sewing machine and recognized that the difficulty was its limitation to sewing only straight seams. Singer and his assistants added the overhanging needle arm, presser foot control of the cloth, and the foot treadle. Singer successfully exploited the invention. For some time, Howe received a royalty of $25 on each machine made in the United States, and in 1860 his patent was extended by Congress for seven years. His petition for a second extension acknowledged receipts of $1,185,000.

THESE HELP TO FEED AND CLOTHE US

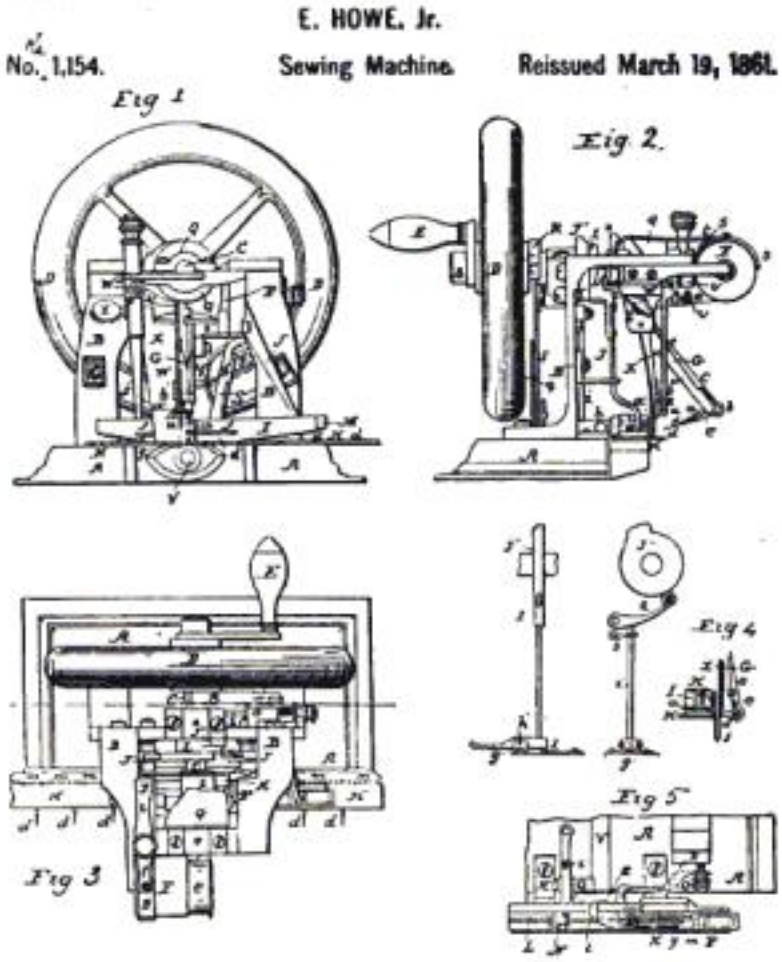
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4. THE AIRPLANE 1906



THE WRIGHTS, Wilbur and Orville, with only high-school education and the mechanical experience of a bicycle repair shop, studied previous glider findings and produced a power-driven, man-carrying airplane. Their experiments reduced their problem to discovering a way of maintaining lateral balance and obtaining lateral and vertical steering. Their patent shows that the brothers added warpable wings or ailerons to the existing elevator and rudder. A powered machine was flown at Kittyhawk, N. C., on December 17, 1903, in the presence of only five persons and with negligible press notice. The Wrights offered the invention to the United States and British governments, but were turned down. The French Government ordered 30 machines when Wilbur flew 56 miles in 91½ minutes, winning a prize of 20,000 francs. The French Academy of Sciences awarded the Wrights a gold medal; French patents were sold for $100,000. Orville Wright's flight of 50 m.p.h. at Fort Myer, Va., to win a $25,000 bonus offered by the U. S. Army convinced the American Government that the airplane was a potential military weapon.

5. THE AIR BRAKE 1869



WESTINGHOUSE worked in his father's shops for making farm implements, went to Union College for three months, and saw service as an assistant engineer in the U. S. Navy during the Civil War. That was his background for invention. He invented a replacer for derailed railway cars, and this showed him the need for a braking system that would be an improvement on the hand brakes of the period. Young George, then aged 23, devised a brake operated by compressed air controlled by the engineer. His original patent was further improved by the triple valve that kept the system under pressure but set the brakes automatically when the pressure was interrupted.

6. OIL CRACKING 1913



WILLIAM BURTON, discoverer of a way to increase the yield of gasoline from oil, was employed by the Standard Oil Co. of Indiana as its first chemist, and later became its president. After early attempts to get more gasoline from oil by the use of heat, reagents, or catalysts had proved unsatisfactory, Burton found that the combination of a 735-degree F. temperature and 95 pounds' pressure per square inch produced the desired result. Crude oil was thus cracked into a lot of gasoline and a little coke.

7. THE STEAMBOAT 1809



ROBERT FULTON, while studying art in London, saw the steam engine invented by James Watt and began experimenting to prove that it could be adapted to the propulsion of boats. When he had solved the problems that had stumped previous inventors, he built the *Clermont* with the financial aid of Robert Livingston, ambassador to France. In 1807 the steamboat made the 150 miles from New York to Albany in 32 hours. Fulton and his backer built 10 steamboats in eight years for service around New York.

8. VULCANIZED RUBBER 1844



CHARLES GOODYEAR took five years to discover how to remove the surface stickiness of rubber, and eight years more to develop vulcanization against sensitivity to temperature changes. He accidentally found that rubber mixed with sulphur and dropped on a hot stove was charred instead of melted, but it took him two years more to discover the degree of heat necessary for vulcanization, and how to apply it. He was jailed for debt many times and died owing $200,000.

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THESE GAVE US MODERN TRANSPORTATION

4

PATENTED MAY 22, 1906.
No. 821,393.

O. & W. WRIGHT.
FLYING MACHINE.

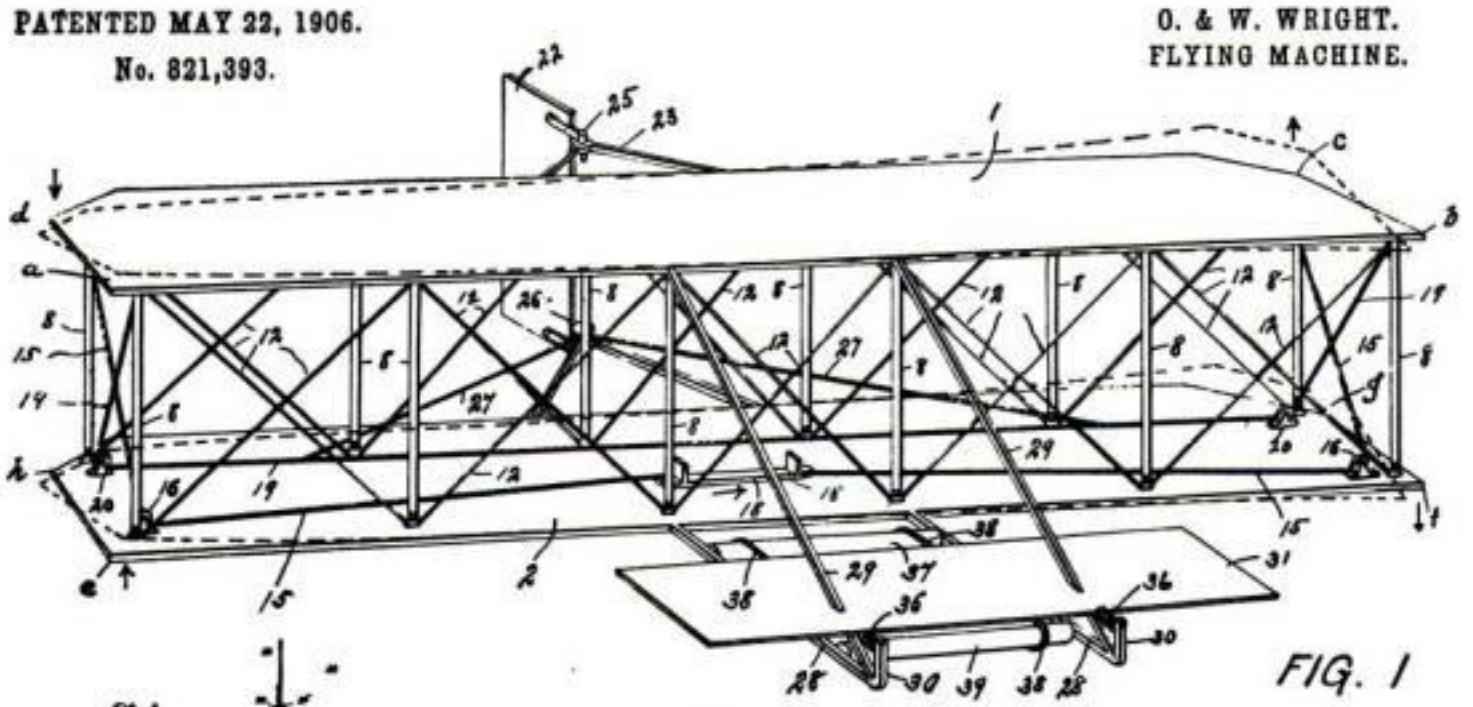
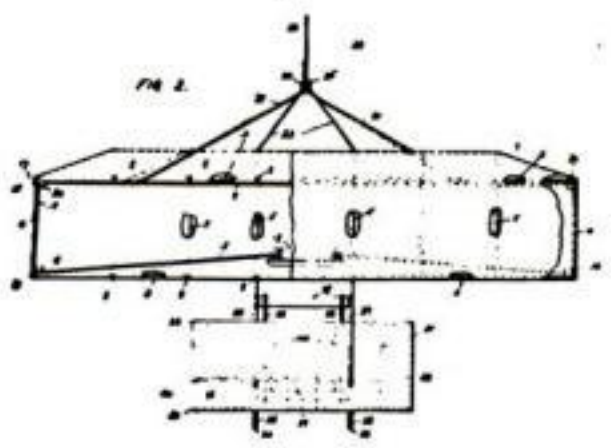
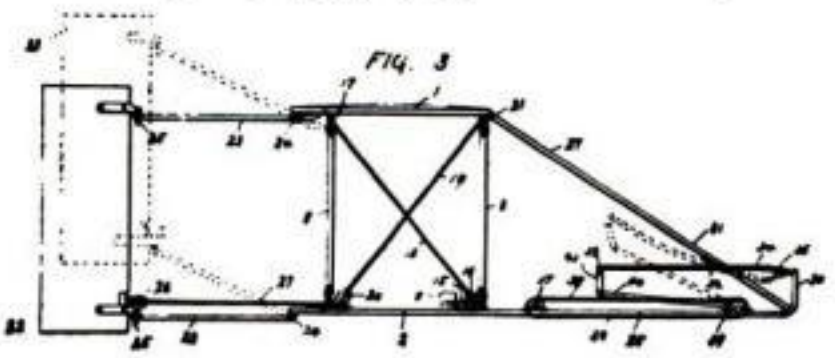


FIG. 1





5

G WESTINGHOUSE, Jr
STEAM POWER BRAKE.

No. 88,929 Patented Apr. 13, 1869.

Fig. 1

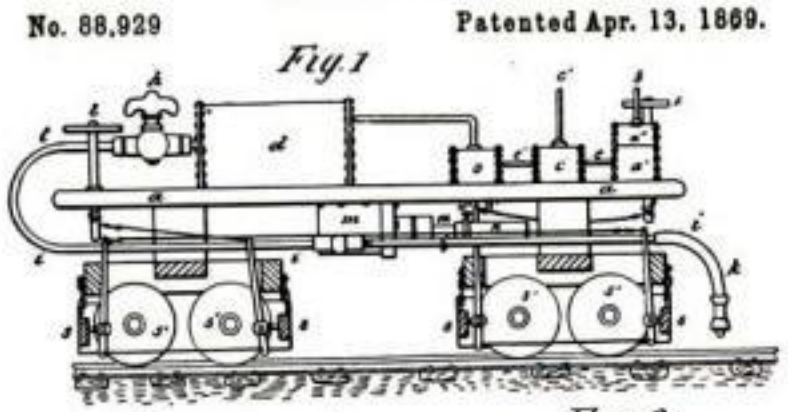


Fig. 5

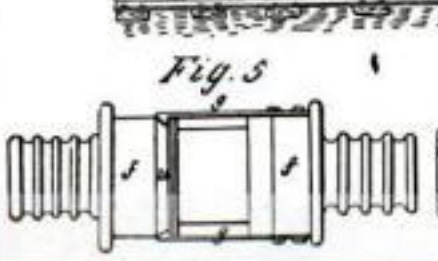
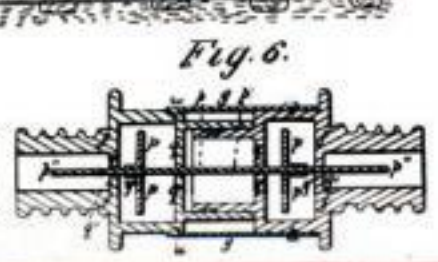


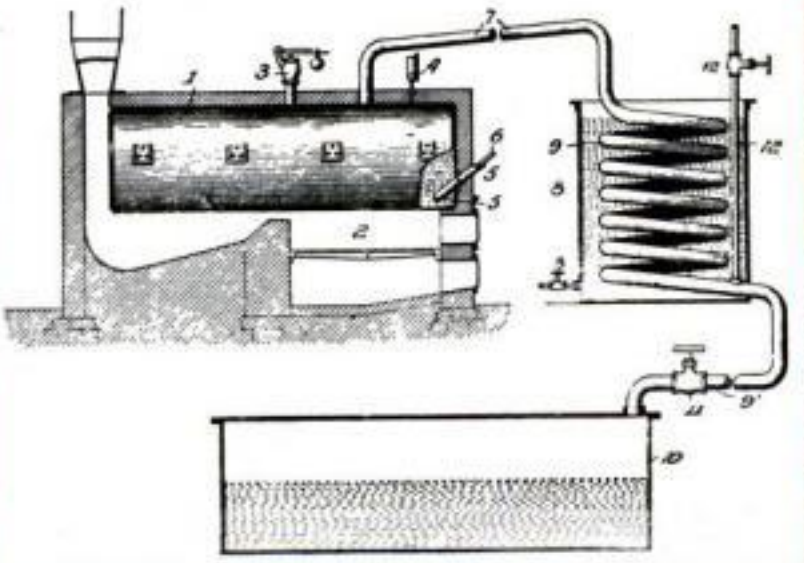
Fig. 6.



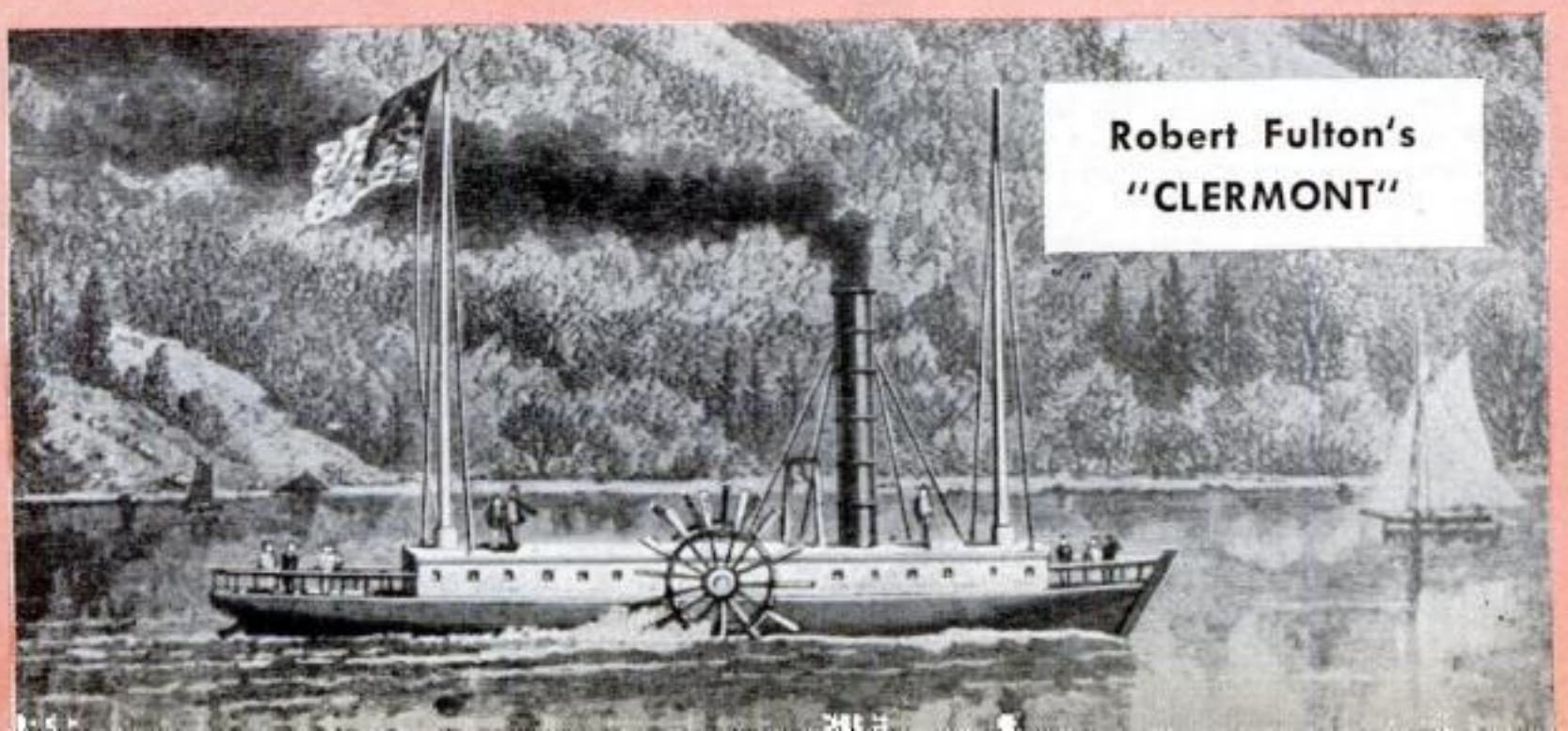
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W. M. BURTON.
MANUFACTURE OF GASOLENE.

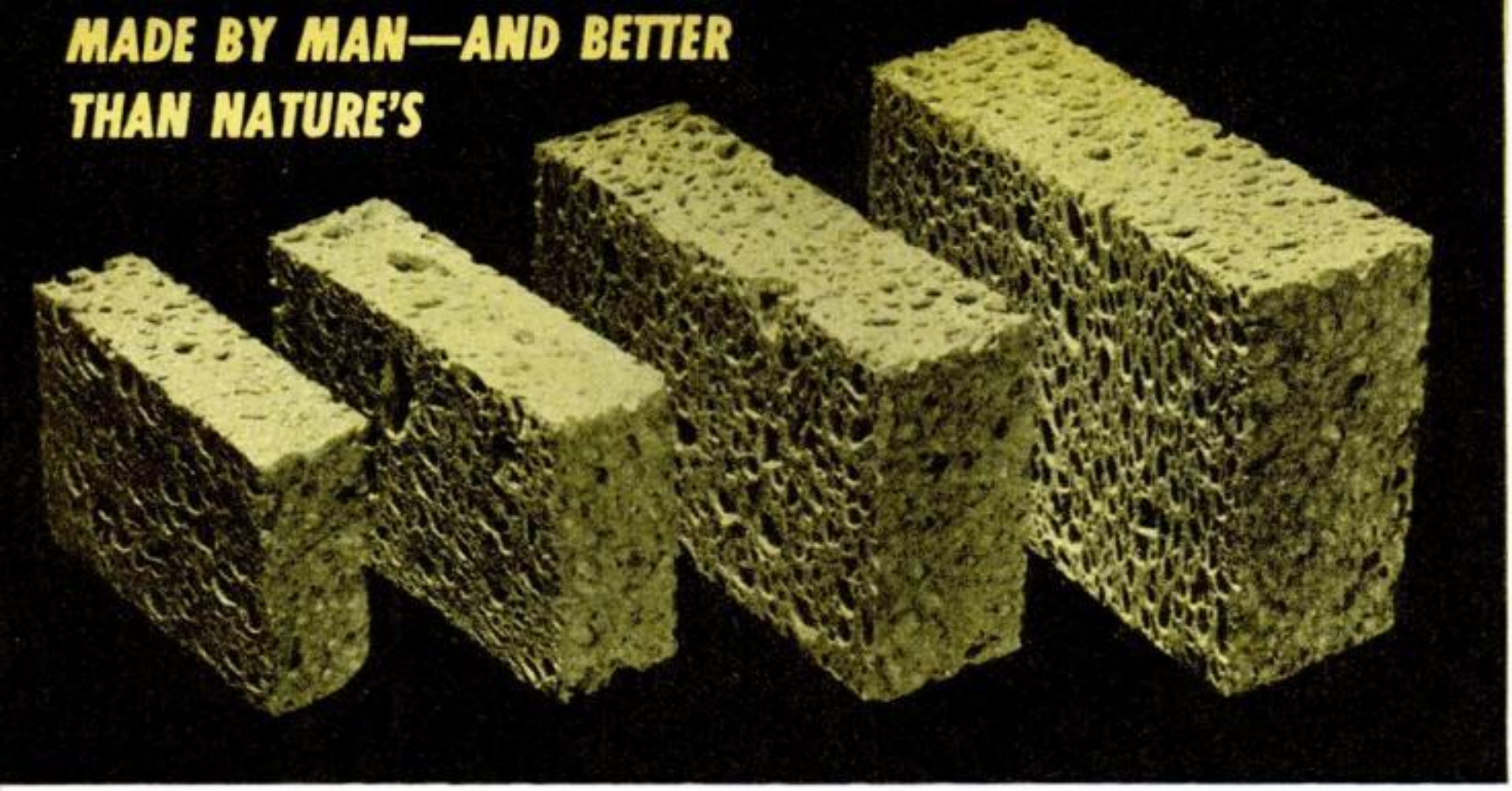
1,049,667. Patented Jan. 7, 1913.



7



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So successful are synthetic sponges that they are being used for everything from swabbing big guns to mopping a surgeon's brow. Those above, left to right, are used for washing dishes, cleaning windows, scrubbing walls and floors, washing automobiles

Now Sponges Grow on Trees

Made of cellulose from wood or cotton, synthetic product can sop up 20 times its weight in water.

By VOLTA TORREY

Photographs by WILLIAM W. MORRIS

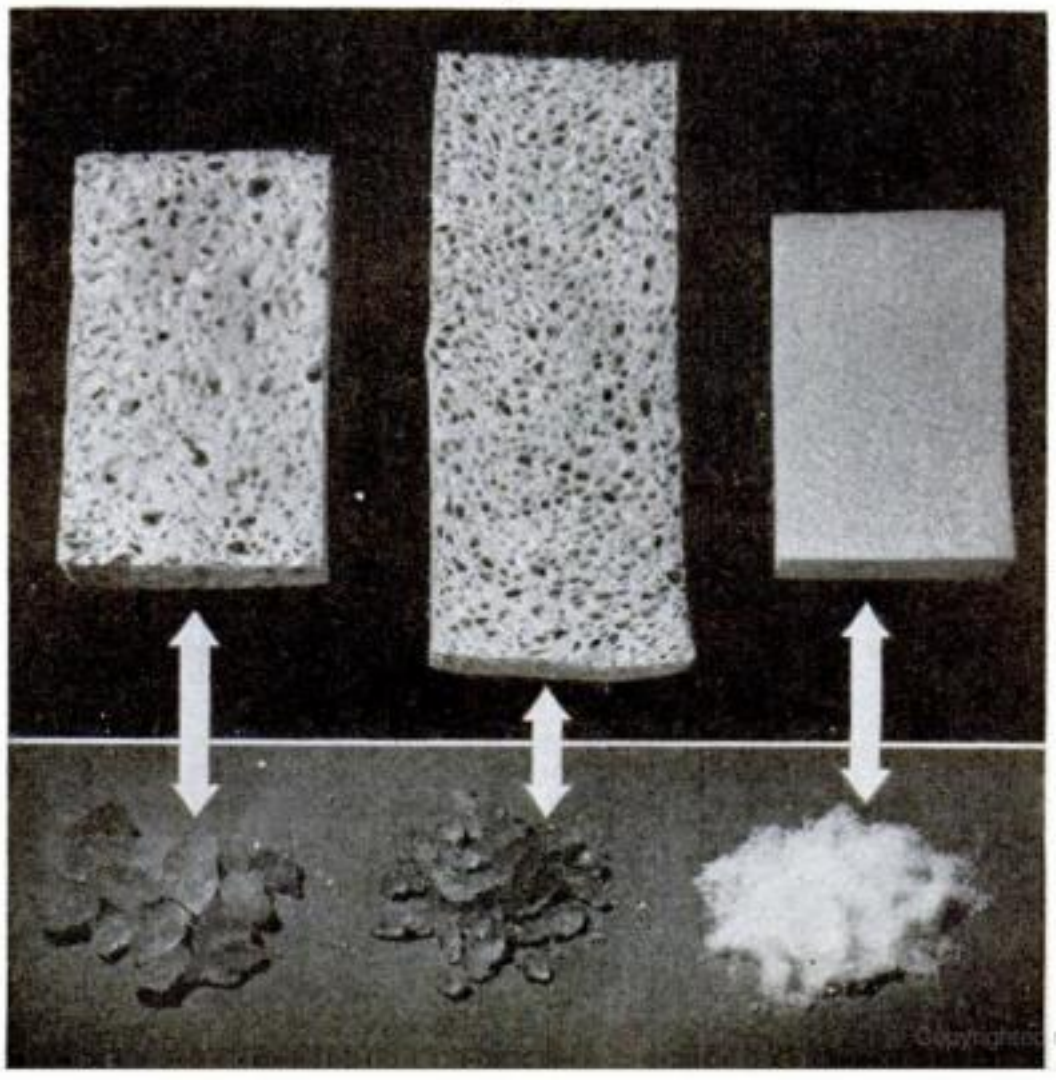
This is the age of cellulose as much as it is the age of iron and steel.—Encyclopedia Britannica.

SPONGES made from trees are outdrinking the Old Soaks of the sea. Synthetic sponges have been used during the war for such various jobs as swabbing big guns, removing sweat from surgeons' brows, drying photographic film, and putting paint on women's legs in place of silk stockings. After the war, these cellulose sponges also will make it easier to keep your home as spotless as a Dutch housewife's kitchen.

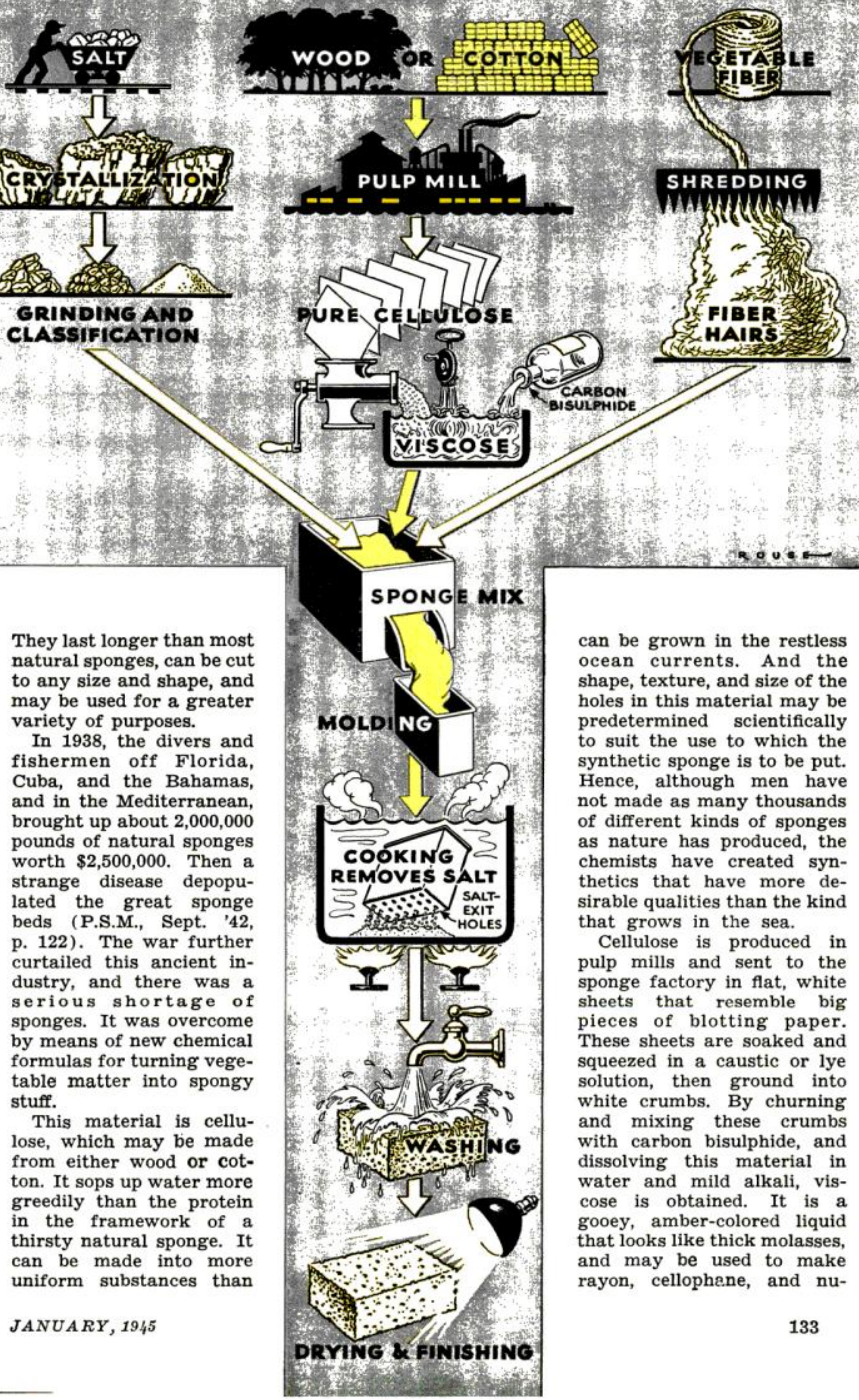
The chemists who created these substitutes for the skeletons of oceanic creatures contend that for most purposes the imitations are better than the real things. Synthetic sponges float, have no odor, and will suck up 20 times their weight of water.

HOW THE NEW SPONGES ARE GIVEN THEIR PORES

Salt crystals that are added to the sponge mix and then dissolved out during the cooking (see diagram on opposite page) produce pores of the desired size in a sponge. Crystals ranging from rock-candy size to fine powder (lower right) respectively produce a standard-pore sponge, generally employed in heavy cleaning; an intermediate-pore sponge often used in housewives' mops; and a fine-pore sponge such as is used on photographic film. All are said to be tougher and more absorbent than similar ones made by nature



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They last longer than most natural sponges, can be cut to any size and shape, and may be used for a greater variety of purposes.

In 1938, the divers and fishermen off Florida, Cuba, and the Bahamas, and in the Mediterranean, brought up about 2,000,000 pounds of natural sponges worth $2,500,000. Then a strange disease depopulated the great sponge beds (P.S.M., Sept. '42, p. 122). The war further curtailed this ancient industry, and there was a serious shortage of sponges. It was overcome by means of new chemical formulas for turning vegetable matter into spongy stuff.

This material is cellulose, which may be made from either wood or cotton. It sops up water more greedily than the protein in the framework of a thirsty natural sponge. It can be made into more uniform substances than can be grown in the restless ocean currents. And the shape, texture, and size of the holes in this material may be predetermined scientifically to suit the use to which the synthetic sponge is to be put. Hence, although men have not made as many thousands of different kinds of sponges as nature has produced, the chemists have created synthetics that have more desirable qualities than the kind that grows in the sea.

Cellulose is produced in pulp mills and sent to the sponge factory in flat, white sheets that resemble big pieces of blotting paper. These sheets are soaked and squeezed in a caustic or lye solution, then ground into white crumbs. By churning and mixing these crumbs with carbon bisulphide, and dissolving this material in water and mild alkali, viscose is obtained. It is a gooey, amber-colored liquid that looks like thick molasses, and may be used to make rayon, cellophane, and nu-

SYNTHETIC SPONGE IS JACK-OF-ALL-TRADES



MAKE-UP, such as the leg paint women use in place of stockings, goes on quickly and evenly with one of the new small-pore sponges



HOUSEWIVES find the new cleaning sponges hold more water, can be easily wrung out merely by pressing them, are unaffected by most cleaning chemicals



DESK SPONGES for wetting stickers have a skin on their sides which permits them to be removed and used without handler getting his hands too wet



CAR-WASHING sponge, with skin on its side which can be used as a chamois, lies on roll of cellulose. Below, roll of this type of sponge is seen being cut



merous plastics as well as sponges.

The only other ingredient of a synthetic sponge is vegetable fiber, which is run through a shredder where it is chopped into tiny hairs to be mixed with the viscose. Without these hairs, the sponges would be like bricks made without straw. The fiber is the binding agent that holds the cellulose together.

The process of manufacturing synthetic sponges both begins and ends with nothing but cellulose and fiber. But something else is needed to create the pores, which is the most difficult part of the business. Salt crystals that dissolve and disappear produce the desired holes. These salt crystals look like yellow cough drops, and are simply dumped into the mixing machine with the viscose and fiber hairs.

The salt, viscose, and fiber must be mixed, however, with much care and precision. The machine is not simply permitted to run for so many minutes or seconds; instead, its blades are allowed to make only a certain number of revolutions to mix the three materials. Then the mixture is promptly dumped into molding cans.

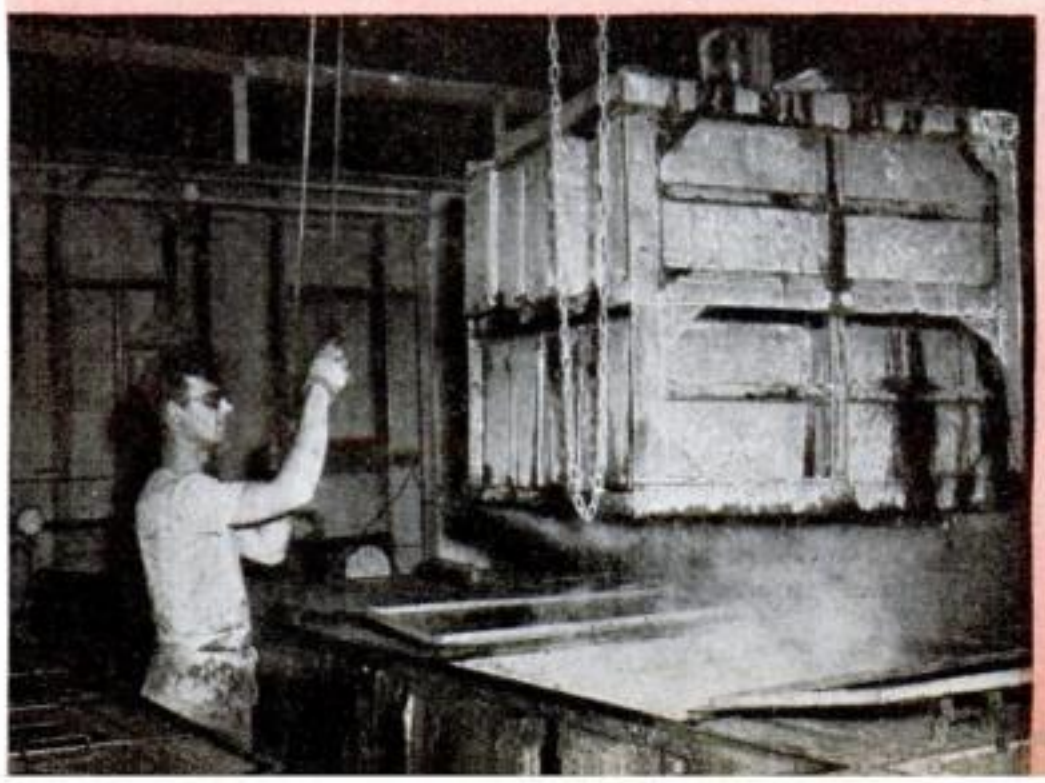
These steel containers are lowered into a steaming chemical bath that contains a hot salt solution. This cooking both hardens the viscose and dissolves the salt crystals so that they leave cavities throughout the substance. The salt drains out through little holes in the bottoms of the cans. When finally lifted out of the boilers, each mold contains a dirty-looking, greenish cake of stuff that needs only

VISCOSE, SALT, AND HAIRS



1 A great blob of gooey, amber-colored viscose goes into the mixer. It is produced by adding carbon bisulphide to cellulose, dissolving in water and mild alkali

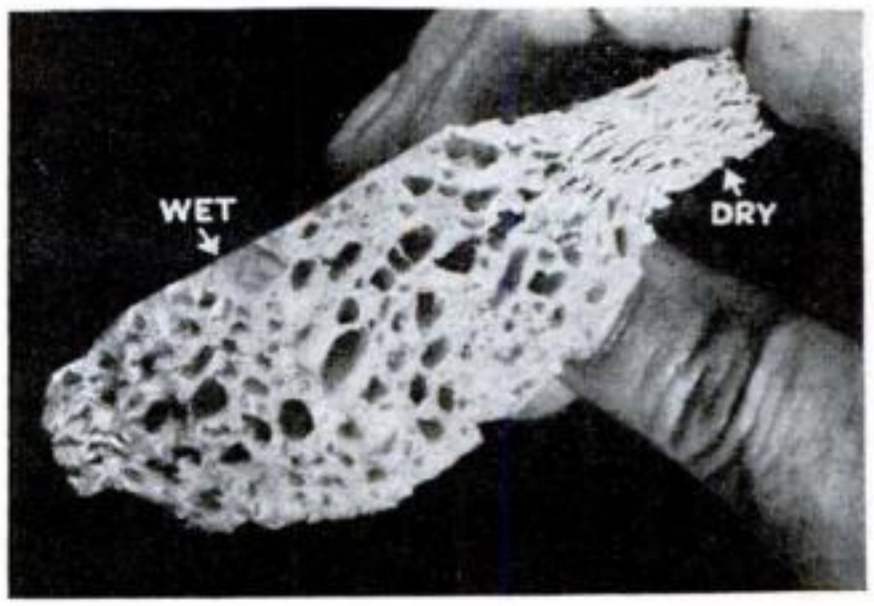
4 Cans are lowered into the boiling bath of chemicals. It is during this part of the process that the salt crystals drain off to leave pores throughout the sponges



to be cleaned and dried to be used as a sponge.

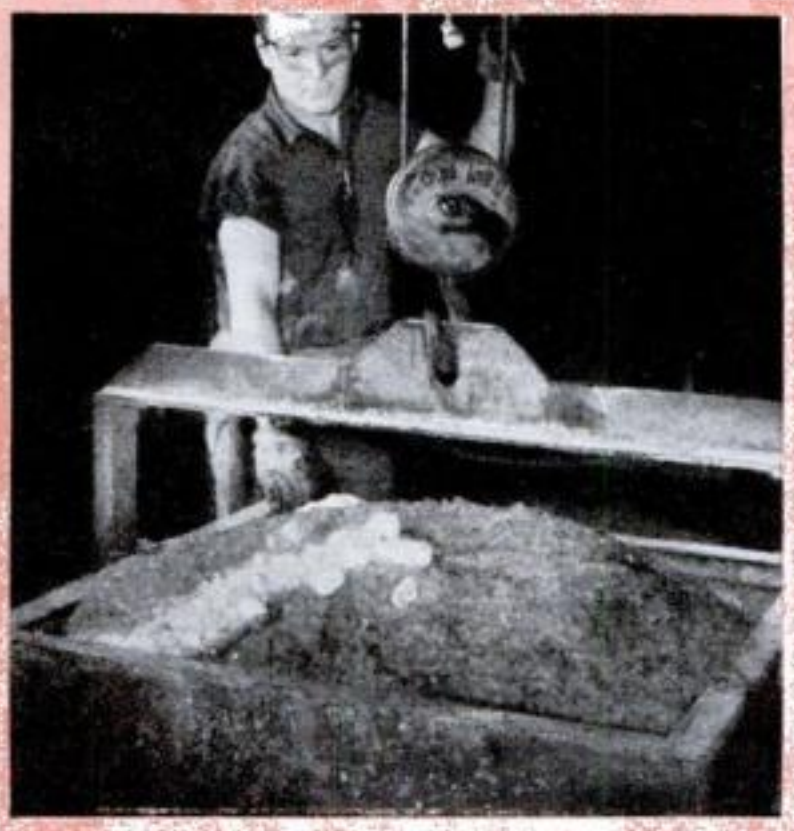
These blocks are washed with pure water and further cleansed with chemicals until they become a bright yellow. This cleaning is similar to that which is necessary when natural sponges are taken from the sea. The sponge blocks then are placed in a whirling centrifuge, after which they are further dried in ovens until they become a pale yellow. The whole process takes about 10 days.

The size of the holes in the synthetic sponge may be varied by changing the size of the salt crystals and the length of the fiber hairs placed in the sponge mix. For applying make-up, a woman may want a sponge with very fine pores. For bathing, one with larger pores may be preferred. And for scrubbing a floor, a sponge with big pores may be *(Continued on page 208)*



UNUSUALLY ABSORBENT, the synthetic sponge will hold up to 20 times its weight in water. When wet, it swells up to three times its normal size, as seen above. When dry, it can be compressed to one third normal size to conserve space in shipping. Specially treated sponges soak up only gasoline for fire prevention on warplanes

GANG UP TO BEAT THE PRODUCT OF MARINE ANIMALS



2 Salt crystals, chopped and sorted for size, are now added to the mix. Later dissolved, they will leave holes in sponges



3 Now the mix is put into cooking cans which give the sponges their bricklike shape. When cans are filled, contents are leveled off flush with tops of the cans

5 After being taken from the cans, blocks are washed thoroughly, put in centrifuge (below) to remove moisture, and then in ovens for further drying



6 The sponge blocks are now cut to size and shape. Note knobs, formed by holes through which salt crystals drained from cooking cans





HOW TO READ A WEATHER MAP

By ERIC SLOANE

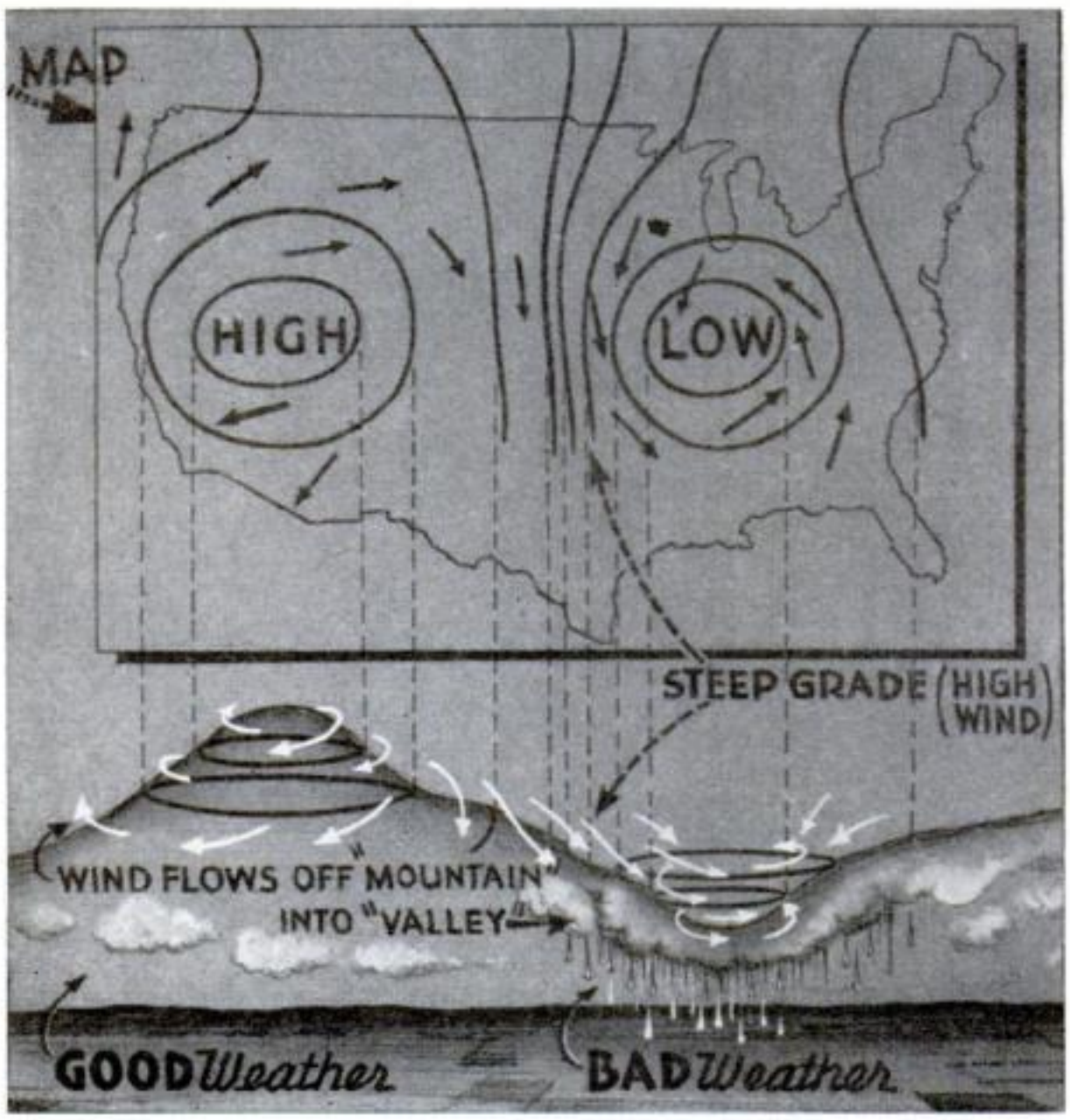
NOW that the weather is no longer a military secret, many American newspapers have resumed the practice of publishing the daily maps prepared by the Weather Bureau. If your local paper provides this service, you have before you a picture that shows weather conditions for the nation as a whole and what is ahead for your own locality — provided you can interpret its meaning.

One of the first things you notice about a weather map is an arrangement of lines resembling contours. The resemblance is more than superficial, for these "isobars," passing through points of equal barometric pressure, mark the outlines of mountains and valleys of air. Isobars encircling an area marked "high" define the slopes of a mountain; around a "low" area, they show the slopes of a valley. Where they are far apart, the slope is gradual; when they are close together, it is steep. At one end of each isobar, the pressure is indicated in inches of mercury; at the other, in millibars.

Another key feature in this war map of the elements is the marking of "fronts," showing the skirmish lines of invading masses of air. There are four kinds of fronts: cold, warm, stationary, and occluded. Each is represented by a different kind of line, and each means a different kind of weather, as illustrated on the opposite page.

Arrows represent wind, moving clockwise around "highs" and counterclockwise around "lows." Where isobars are close together, winds will be high. Since weather moves generally eastward at regular speed, you can easily tell from a study of the map what's coming in the next few days.

Weather maps have changed somewhat since before the wartime ban. The marking of the fronts is a significant addition. The velocity scale on wind arrows is now omitted.



The typical weather map at the right contains all the symbols commonly used in the official Weather Bureau maps published in many newspapers. What these symbols represent, and what they mean in terms of weather, is shown in the drawings. By applying these rules to your daily map, you can be your own forecaster of the weather in the area of your home

This drawing illustrates in graphic fashion the meaning of the isobars as contour lines marking the slopes of mountains and valleys of air. You can visualize fluid air falling clockwise down the mountains and swirling into the valleys counterclockwise

Drawings by the Author

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WEATHER USUALLY MOVES **EASTWARD**
500 to **700** Mi. DAILY
FAST IN WINTER

FRONTS ARE FACES OF AIR MASSES
COLD AIR
FRONT
FRONT
WARM AIR
LOOK FOR CLOUDS & WEATHER CHANGE

COLD FRONT ( ) HAS CUMULUS & BRIEF STORMS
100 Mi.
PLOW OF COLD AIR

A **STATIONARY** FRONT ( ) DOES NOT ADVANCE
FRONT
(LOW WIND
LONG RAIN

ISOBARS FAR APART= **LOW WIND**

CLOSE ISOBARS = **HIGH WIND**

1011
1008
1005
29.68
1008
1011
1014
1017
HIGH
LOW
1005
29.94
29.86
29.77
29.77
29.86
29.94
PRESSURE HERE IS EQUAL to 29.77 INCHES OF MERCURY.

A HIGH IS A "MOUNTAIN" OF AIR
1017
WEATHER IN "HIGH" IS **GOOD,** WITH FEW CLOUDS

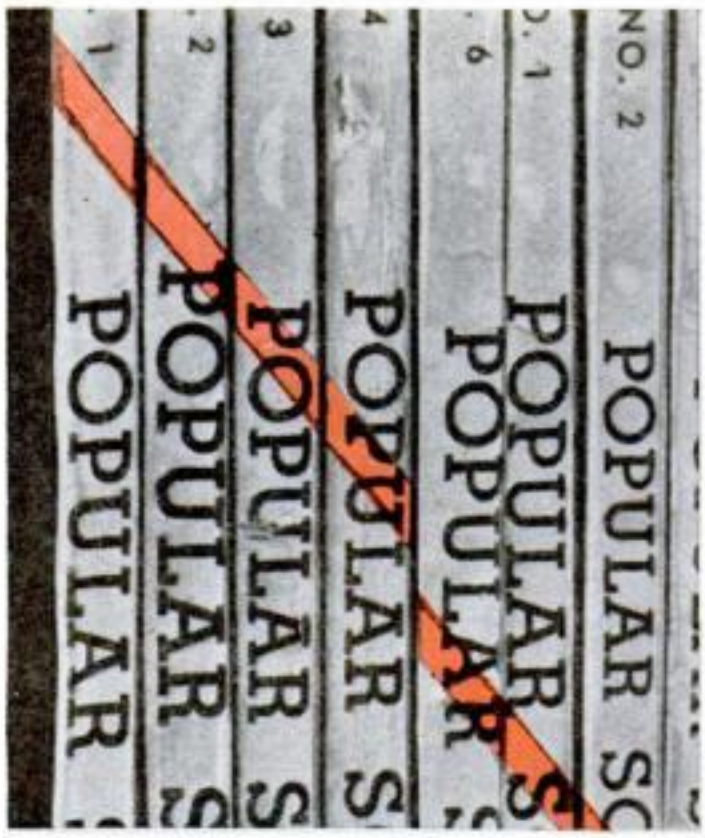
A **LOW** IS A "VALLEY" OF AIR
LOW
1005
A "SINKHOLE" FOR BAD WEATHER

AN **OCCLUDED** FRONT ( ) IS WHERE COLD OVERTAKES WARM AIR
COLD FRONT
WARM FRONT
LIFTS FRONT INTO HIGH CLOUD SHAPES

WARM FRONT ( ) HAS A SLANT CEILING & STRATUS-TYPE CLOUDS
1000 Mi.?
LONG, DULL RAIN

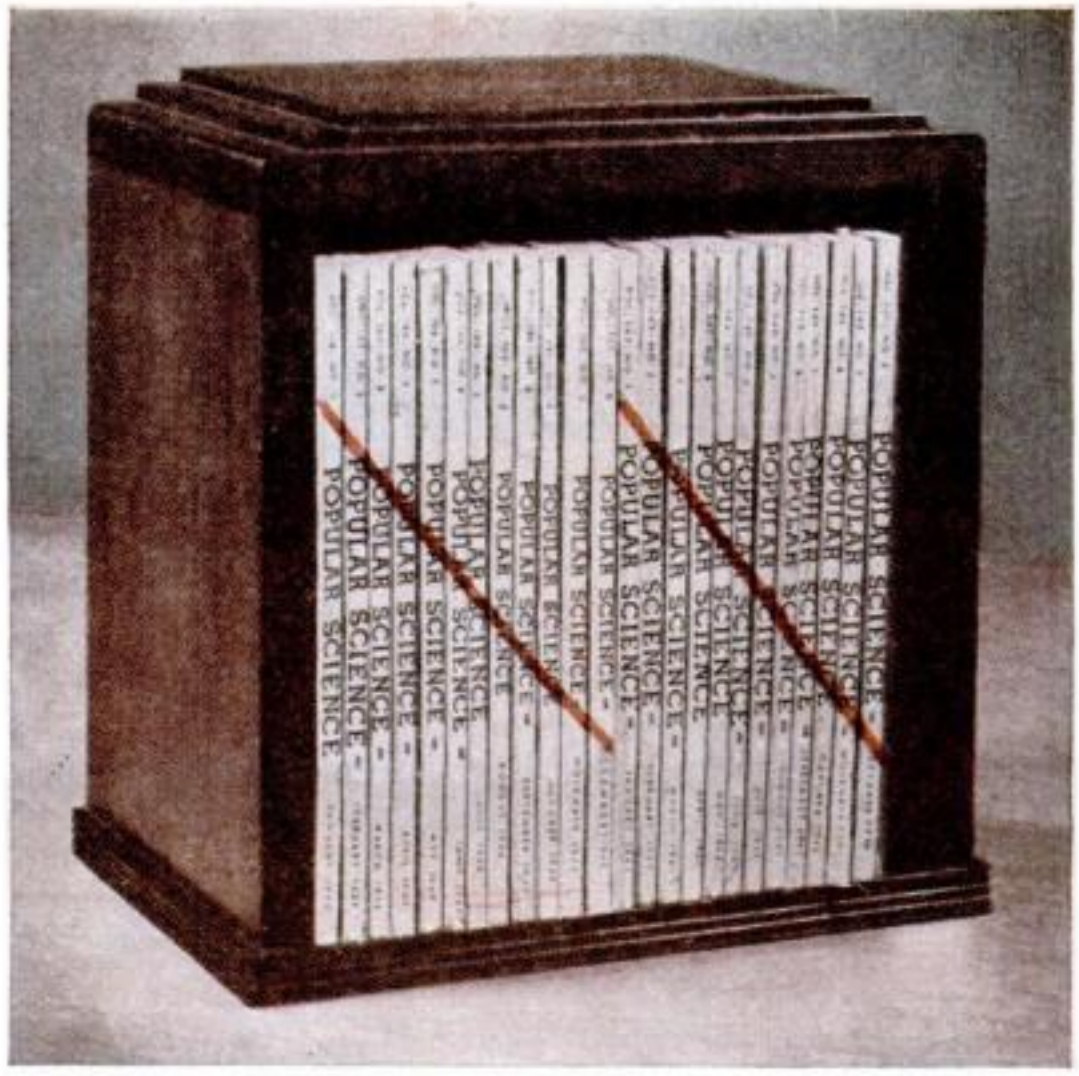
NOTE HOW WIND BLOWS **OUT** OF HIGH **INTO** LOW
HIGH
LOW
CLOCKWISE
COUNTERCLOCKWISE

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NO. 5 MISSING

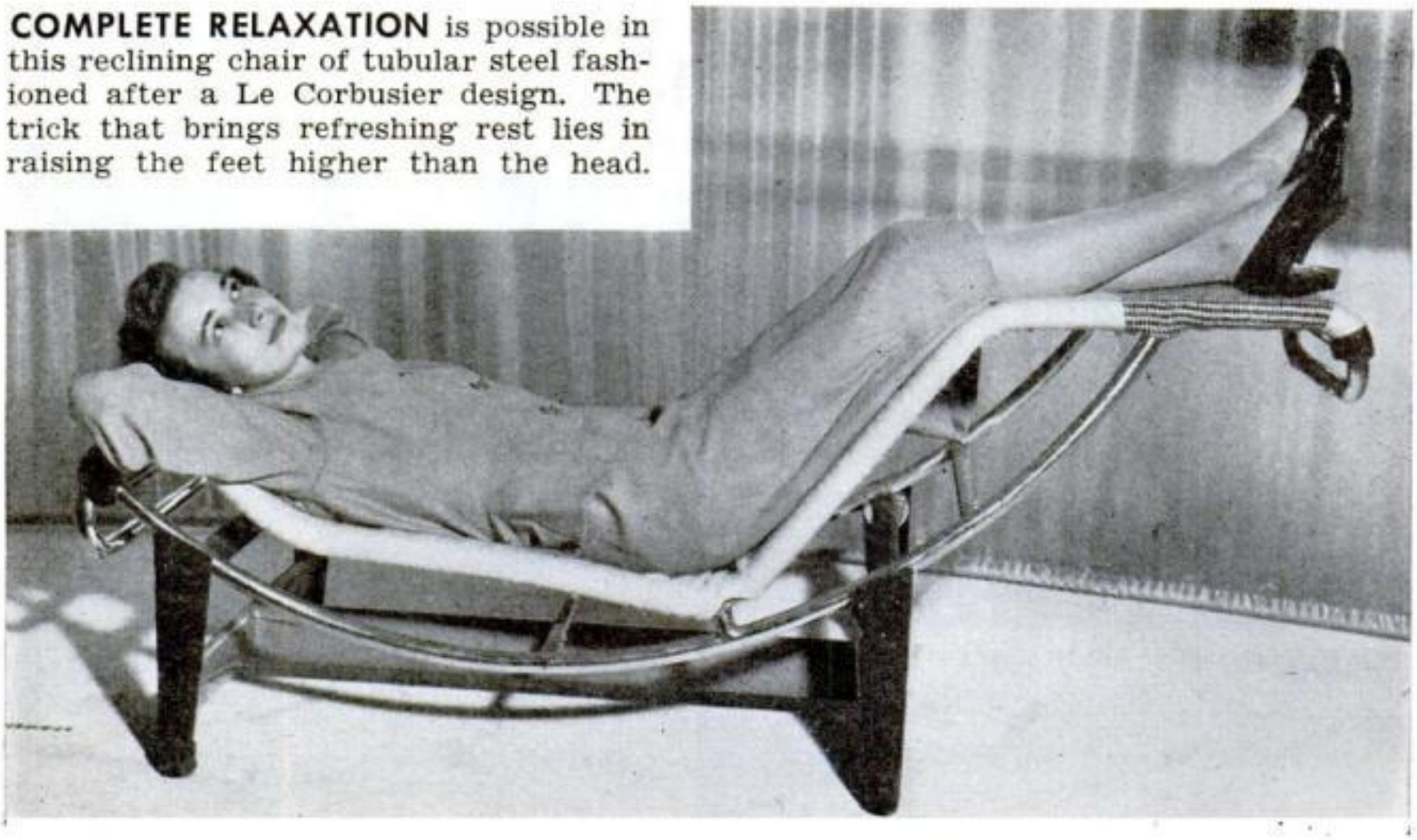
Just a glance is necessary to show you that, since the red stripe is broken, a copy is missing from the above file



New Popular Science Visual Filing Aid

BEGINNING with this issue, a broad red stripe will appear on the back of each copy of P.S.M. When 12 consecutive issues, January through December, are stacked together in their proper sequence, the stripes will form an unbroken diagonal line across all the issues. This is done so you can check the completeness of your file at a glance and so you can easily spot the place where a copy goes when you are replacing it.

COMPLETE RELAXATION is possible in this reclining chair of tubular steel fashioned after a Le Corbusier design. The trick that brings refreshing rest lies in raising the feet higher than the head.



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What's New in Modern Living

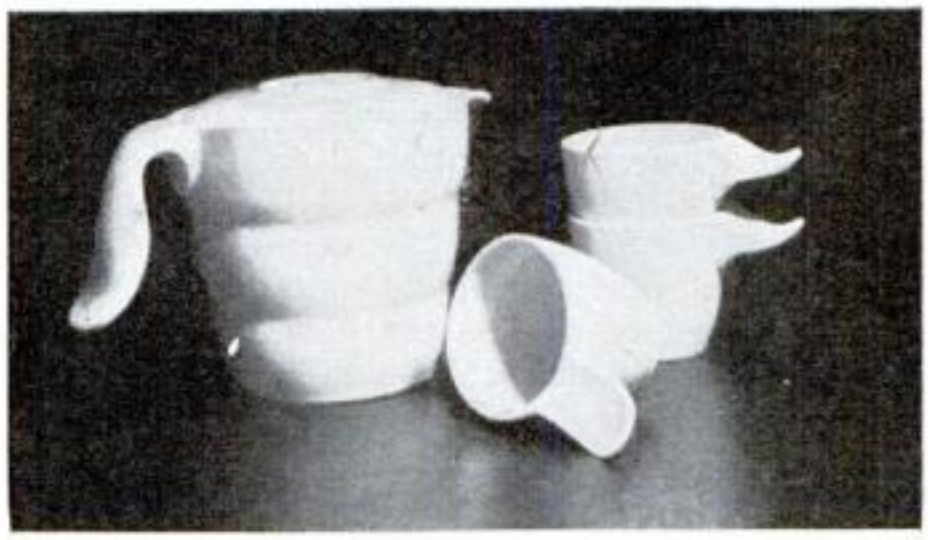
JUST A BUTTONHOLE in one corner will keep a napkin from sliding off a diner's lap. The idea is contributed by Willard Davis, of the Hotel and Restaurant News.





COMPACT COLLAPSIBLE CUPS for use on picnics and while traveling are now made entirely of plastic by Plastic Molded Products, Inc., of Los Angeles. They don't leak when pulled open.

LIGHTWEIGHT PITCHERS, cups, and other pieces in modern design come in durable, economical ware for the double purpose of use in both the kitchen and dining room. Cups fit into each other to save storage space.





DUSTING AND POLISHING are done with a new material—a handful of absorbent white cotton threads. The yarn, available in two household-size packages, is disposed of after use, eliminating the washing of soiled cloths. It is made by Kauders-Steuber Company, of Chicago.

COLORED PLASTICS are employed in the manufacture of bathroom fixtures, including a soap dish, a tumbler holder, and a soap-dish holder with a removable dish. The plastic used is Tenite. E. B. Kingman Co., of Leominster, Mass., now turns out the fixtures for Navy yards.



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Gus and the Scrambled Transmission

By MARTIN BUNN

DOC HOCKENJOSS lives in a fine old farmhouse that his great-great-grandfather built on land that is now part of a swanky district on the edge of our town. But there's nothing swanky about Doc. He's rough and ready in appearance and brusque and salty in speech; he often says he hates folks who put on airs, and he refers to himself as a "hoss doctor." As a matter of fact, he's a top-flight veterinarian who is as good with pampered Pomeranians as he is with colicky cows, and he has a practice that keeps him hustling.

Something went wrong with Doc's car one night shortly after Stan Hicks had started working for Gus. He was called out into the country to attend a sick horse, and the job turned out to be a long one. It was wet, and along toward midnight it got cold. The farmer produced a quart of applejack and, by the time the horse was out of danger, he and Doc had emptied it and made a good start on another.

Doc got home at 5 A.M. feeling a little the worse for wear, but he did something that he never forgets no matter how tired—he turned his car around and backed it into the barn so that if he should get a hurry call it would be headed right and ready to roll. Just then the applejack got in its dirty work, and Doc backed into the wall good and hard. He jerked and cussed at the gearshift for a few minutes, trying to get it out of reverse, but he couldn't budge it. So he went into the house, left a note for his wife asking her to phone Gus to come first thing in the morning, and then he went to bed.

Stan got to his house about 9 A.M. Doc, still sleepy, looked out the window. He saw Stan go into the barn and then come out, get into the wrecker, and back it in.

"That blame young fool," Doc muttered. "How does he expect to tow that car front-end first when it's stuck in reverse?"

With that he threw on some clothes and hurried out to the barn. He was just in time to hear Stan start up the wrecker; and then it happened—from the innards of Doc's bus there came a weird banshee shriek and the clatter of disintegrating mechanism, but the wheels began to turn.

Stan looked up and saw Doc standing near the doorway, agony in his face. He grinned triumphantly. "Towing her loosened up the gears, all right, mister," he said with all the cocksureness of youth. "I'll have your bus back in an hour or so." And he drove on out before Doc could regain his speech.

He was still in this satisfied frame of mind when he pulled into the Model Garage some 20 minutes later and Gus asked: "Well, what's the matter with *that* one?"

"I dunno," Stan said. "Nothin' now, I guess, but I thought I'd better bring her in so we could look her over. That old hick backed her into the barn wall, and she stuck in reverse. I couldn't shift her, so I hooked on the wrecker and gave her a yank. That freed the gears, all right."

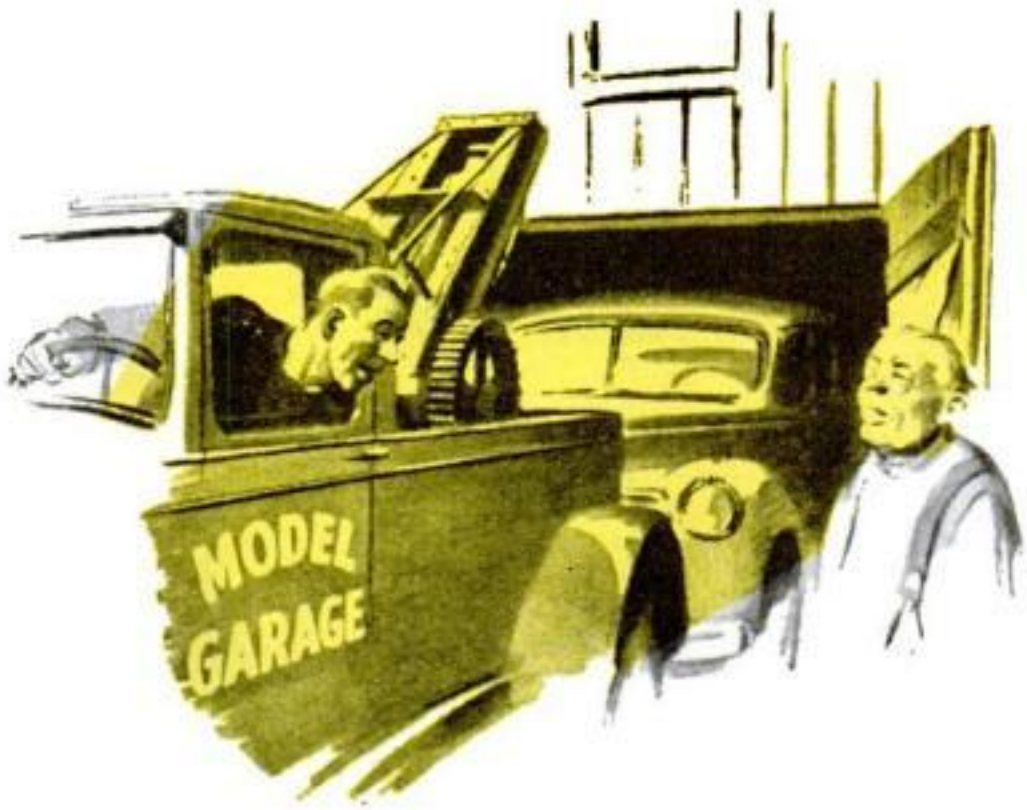
Gus felt a cold sweat on his forehead. "You—you what!" he stammered.

"Want me to check her, or would you rather do it?" Stan went on cheerily.

Gus thought of several things to say, but he held them. "I'll do it," he told Stan grimly. "There's a greasing job over there that you'd better get busy with."

His worst fears were realized

"Towing her loosened up the gears, all right," Stan told him



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Doc dodged across the street and hid himself behind a parked car so he could see and hear what went on

when he went to work. He found that the complicated automatic-transmission mechanism had been ripped to pieces, with many of the small gears ruined, and he knew some of them would be hard to replace. Sadly he went into the office, called Doc Hockenjoss, and told him it would be several days before he could have his car.

"That lunkhead you sent here said I could have it in an hour," Doc roared at him.

"He's an optimist," Gus said. "I'm not. If you'll come in Friday, I'll try to have it ready. You'll have to use your wife's car until then, or I'll lend you mine."

Then he hung up and went back to the shop. There he found Stan gazing at the scrambled mechanism of the automatic transmission.

"What's the matter with it, boss?" Stan asked innocently.

"We won't go into that now," Gus said. "But here's something to remember: *Never use force trying to make any part of a car work.* Get me?"

"Sure, boss, I get you," Stan replied in a subdued voice, and went back to his greasing.

Gus had to make a trip down to the city to locate some of the gears and other parts that Stan had ruined, but he succeeded in rounding them up, and when Doc came in for his car on Friday he had it ready.

"What happened?" Doc asked, and when Gus told him, he whistled. "What's it going to cost?"

Gus had been checking the jobber's bill for the new gears. He passed it over.

Doc took one look and hit the ceiling. "What!" he yelled. "Derned close to $100. I won't pay that!"

"Keep your shirt on," Gus advised him. "You asked what it was going to cost, not who was going to pay. Stan didn't know his job, so the loss is on the house."

"Well, that's fair enough," Doc admitted. "Tell you what, Gus—next time you get sick, call me. I won't charge you a cent."

DOC HOCKENJOSS is a vindictive cuss—when he dislikes anyone, he dislikes for keeps. And at the head of his blacklist is Mrs. C. Sherman Landsmoore. She's an angular woman with loads of money and a vitriolic tongue, and she holds office in every woman's club and uplift organization in the county.

She and Doc speak—usually sarcastically—when they meet, but they make no bones about heartily detesting each other. Mrs. Landsmoore always refers to Doc as "that awful, *awful* man," and he has been heard to call her "that long-toothed mare."

Down on Main Street one afternoon not long ago, Doc saw Mrs. Landsmoore nose her convertible into an angle-parking space. When he came out of a store a little later,

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he saw her still in the car, racing the engine and yanking at the gearshift. Realizing that she was in difficulty, he went over to enjoy himself.

"Havin' trouble, Mrs. Landsmoore?" he asked.

"Yes, I *am* having trouble!" she snapped. "My gears won't shift. But there is no use asking *your* advice."

"Well, now," Doc said with fake geniality. "I don't know much about automobiles, and that's a fact. But a while back I had exactly the same trouble you're havin', and a smart young feller from the Model Garage got my gearshift free in a wink. If I were you I'd get the same feller down here—Stan Hicks is his name. And lots of luck to you."

Grinning, Doc hurried across the street to the Park House lobby where he could keep Mrs. Landsmoore under observation. For another few minutes she continued to tug and yank at the gearshift; then she got out of the car, flounced across the sidewalk, and disappeared into a drugstore.

"She's going to phone!" Doc almost shouted. "Oh, boy!"

A few minutes later he saw her come out, go back to her car, and switch off the engine. A quarter of an hour passed. Then the Model Garage wrecker came along, Stan Hicks driving it. Mrs. Landsmoore flagged him down, and Doc dodged across the street and hid himself behind a parked car where he could see and hear what went on.

"Yeah, I'm Stan Hicks," the grease monkey was saying. "But how come you called me? Nobody else ever has!"

"You were highly recommended by Dr. Hockenjoss," Mrs. Landsmoore told him. "The gearshift of my car is stuck somehow, and he told me that he had experienced the same difficulty and that you had—er—obviated it in a—a wink, I think, was his expression."

Most of the color drained out of Stan's ruddy cheeks. "Stuck gearshift . . . Doc Hockenjoss . . ." he gasped.

"Young man," Mrs. Landsmoore commanded, "stop muttering and do something!"

"Lady," Stan told her earnestly, "I wouldn't touch your car for $1,000 cash."

Mrs. Landsmoore's temper slipped the leash. "Don't you dare be impertinent to me!" she shrilled. "You fix my car the same way you fixed Dr. Hockenjoss's—and do it immediately!"

"Lady," Stan repeated, "I told you I wouldn't touch—"

"That'll do, Stan," Gus Wilson said. He had been driving along Main Street and, seeing Stan and the wrecker, had stopped to lend a hand if one were needed. "What's this all about?"

Mrs. Landsmoore told him—and how!

Gus looked at Stan. "Well," he asked, "why don't you fix Mrs. Landsmoore's gearshift? You know how."

"Huh?" Stan gasped. "You mean fix it the same way I did Doc Hockenjoss's?"

Gus grinned. "There's an easier way—and it's less expensive, too," he said. "Jack up a rear wheel, and then start the engine."

Stan jacked up one rear wheel and started the engine as told.

"Now shift into neutral," Gus went on. The gears shifted sweetly.

"There you are, Mrs. Landsmoore," Gus said politely. "You won't have any further difficulty, I'm sure. . . . The charges? Oh, we'll send you a statement."

WHEN Gus got back to the shop, he found Stan waiting and looking injured.

"All right, kid," Gus said. "You did all right. First chance I get we'll take an automatic transmission apart so you can see how it works. Until then, here's enough to go on with: Some automatic transmissions stick in gear when a car is backed hard against a wall or driven head on into a curb. Once in a while they even stick in high gear when a car is climbing a steep hill.

"If they stick while the car is where it can't be moved a foot or so in the direction it was going, lack of centrifugal action in the transmission prevents the gears from being shifted. Trying to force them by rocking or pushing is dangerous. If you push or pull the wrong way, you're likely to ruin some of the delicate gears in the automatic-transmission unit—the way you did when you towed Doc's car. The only safe remedy is to jack up a rear wheel and start the engine. Then you can shift without trouble."

"O.K., boss," Stan said. "I'll remember that . . . But why the heck did Doc recommend me to that dame?"

Gus laughed.

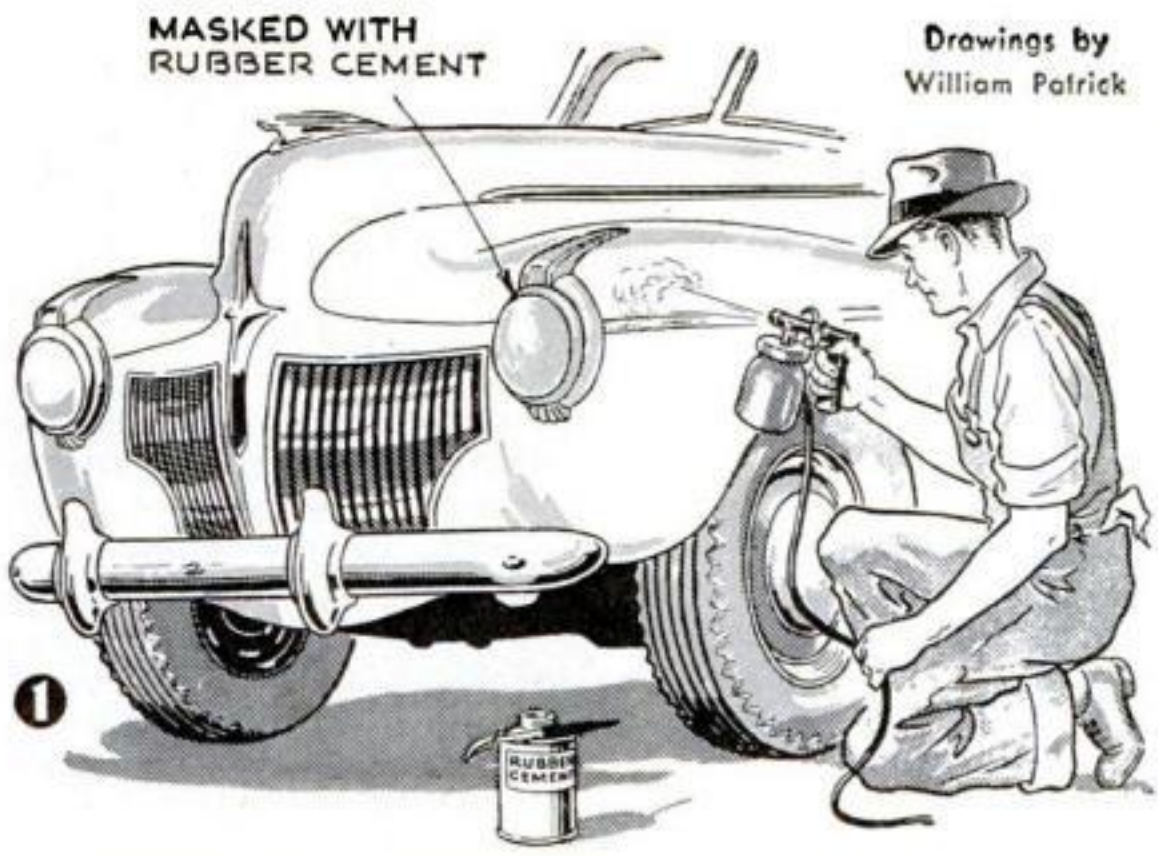
"Don't get a swelled head about that," he advised. "It was no way to treat a lady."

GUS SAYS:

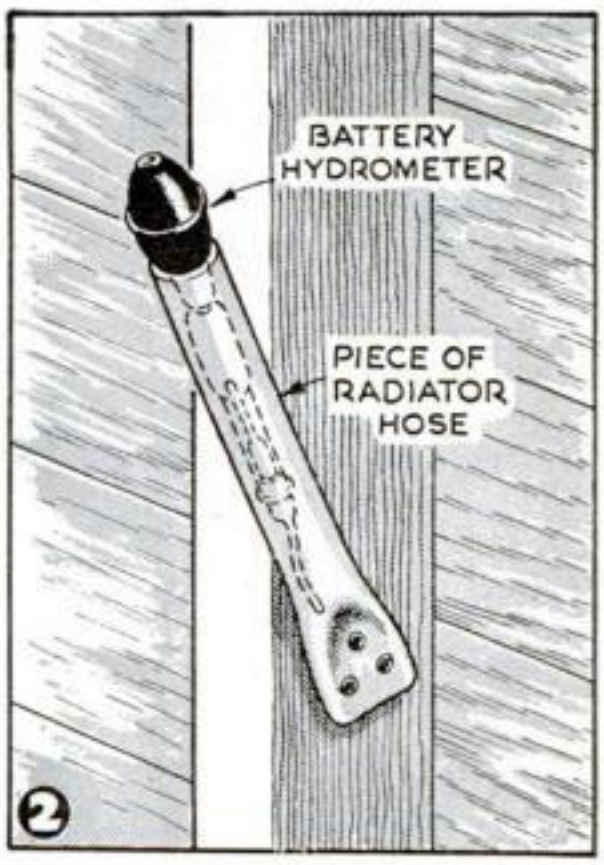
In spite of all warning, lots of folks are driving as if they can get a new car any time they want it. They had better continue their war-born conservation well into peace, though, for when the new cars do come, there won't be enough to go around for some time.

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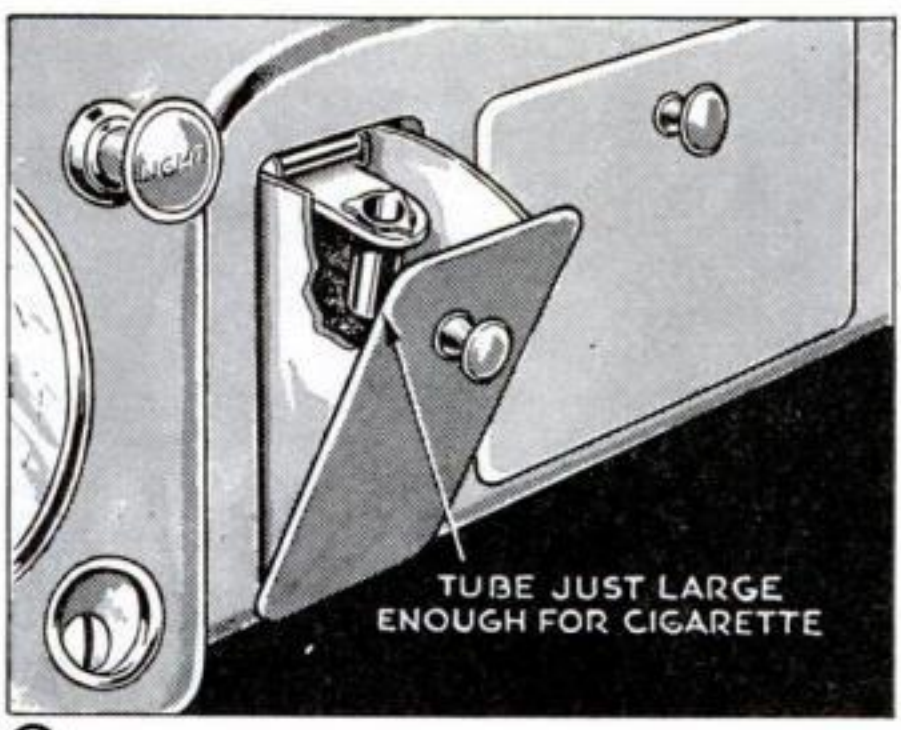
IDEAS FOR MOTORISTS



1



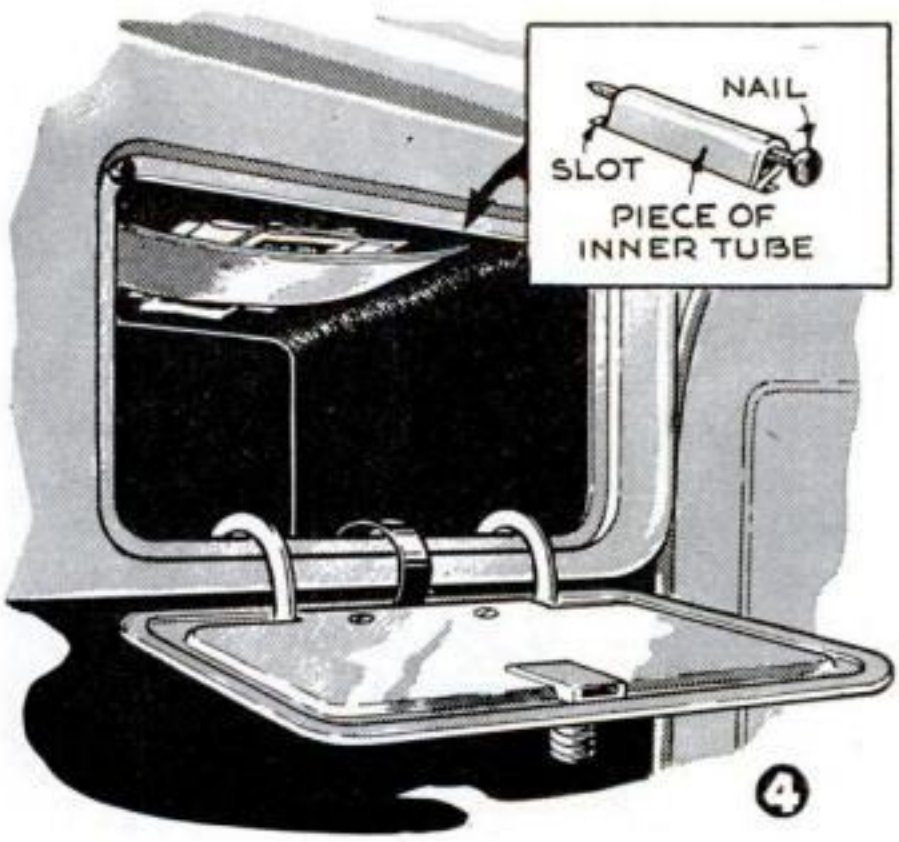
2



3

1 MASKING CHROMIUM TRIM on your car in preparation for a paint job may be difficult with the customary tape. Some of the brightwork may be hard to reach, and some may be so narrow as to make tape awkward to handle. Paint these places—or all the trim, if you like—with ordinary rubber cement. This material peels off easily along with paint sprayed on it.—J. J. B.

2 YOUR BATTERY HYDROMETER can be kept in your garage without danger of breakage if you enclose it in a short length of discarded radiator hose. Nail the hose by one end to a stud, letting the upper part project at an angle, as shown in the drawing, and insert the hydrometer.—A. H. W.



4

3 AUTOMATIC EXTINGUISHING of cigarettes, instead of letting them smolder in the bottom of the ash receptacle on your dash, is possible with the addition of a short metal tube the diameter of a cigarette. Drill the extinguishing bar in the ash receptacle for a tight fit, flare the upper end of the tube, and press the tube into the hole. A lighted cigarette inserted in the tube will go out. It will be pushed into the ash receptacle when the next butt is inserted.—K. M.

4 REGISTRATION PAPERS and road maps can be kept conveniently away from other items when held at the top of a glove compartment by a piece of old inner tube. Slot the fiber top of the compartment, slip the doubled end of the tubing through, and hold it with a nail as shown.—W. F. J.

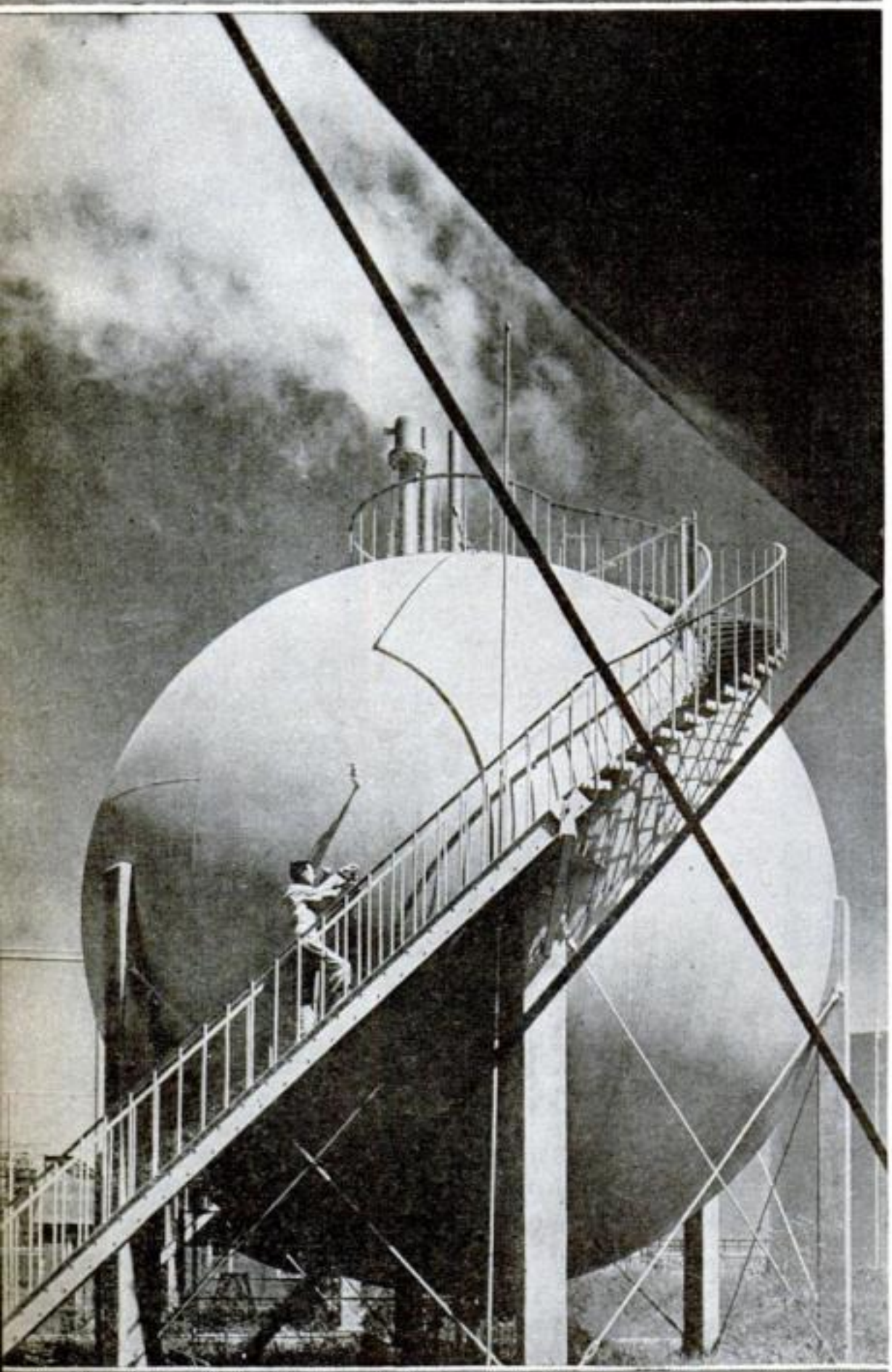
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What Will Be Tomorrow's Motor Fuel?

By HAL BORLAND

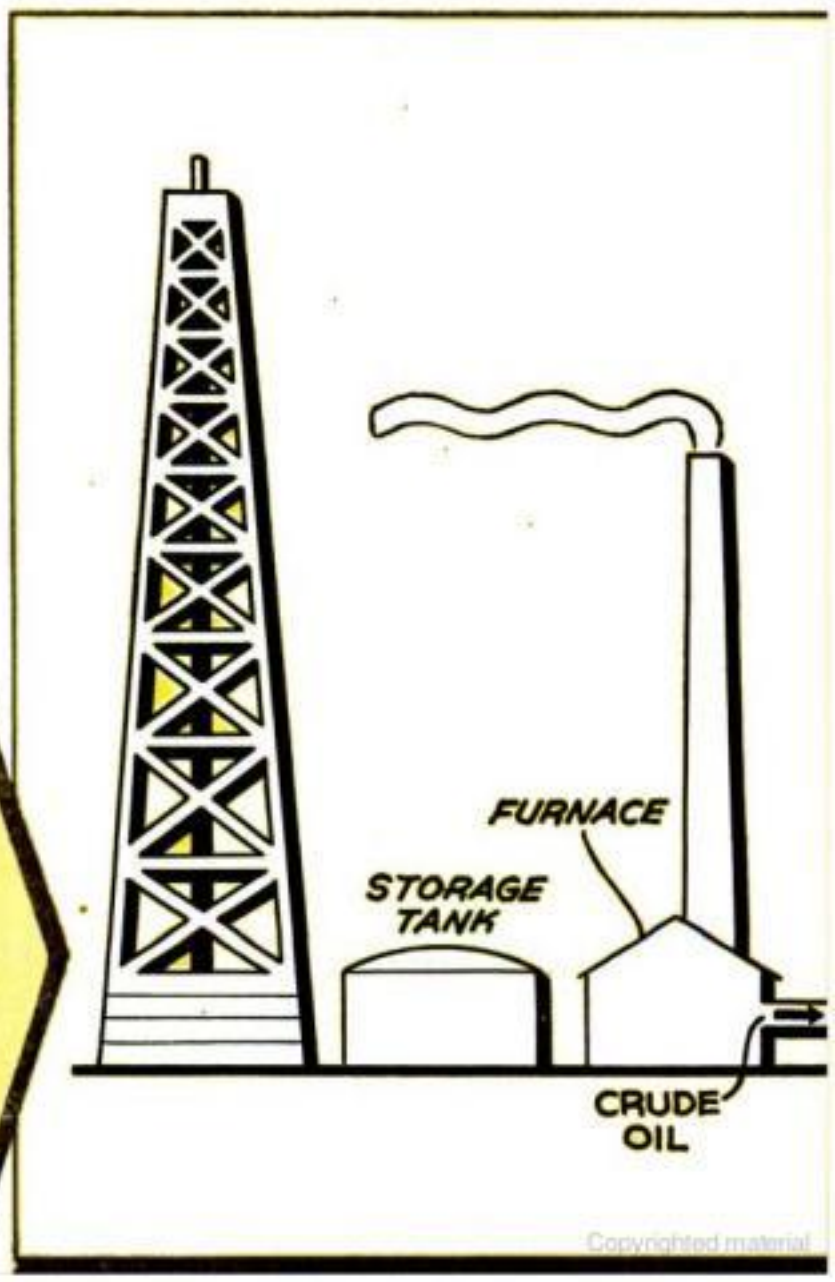
AMONG wartime production triumphs, America's high-octane gasoline output stands in the top rank. In less than four years the improvement in aviation fuels, and in engines to use them, doubled the bomb capacity of our planes, lifted their ceilings above 40,000 feet, added tremendously to their range and speed, and materially reduced their takeoff runs. Whereas seven years ago we were producing only about 800 barrels of 100-octane fuel a day, we are now supplying not only our own tremendous air forces but helping to fuel the air fleets of all our allies. Along with production, research has swept ahead. If it were needed, we could now blend in quantity a fuel twice as powerful as 100-octane gasoline; and we are now making, for limited blending and further research, a fuel called Triptane that's rated four times as powerful as present standard aviation gasoline.

What will these achievements mean to the motorist in the peacetime years ahead? Better fuels, obviously, blended to his special needs and reasonably priced. Better fuels will bring better engines, smaller, lighter, more economical, smoother in operation. Compres-



Built like a huge steel ball to withstand pressure, this tank holds the volatile hydrocarbons used in high-octane gasoline

FLOW CHART SHOWING THE MAJOR STEPS IN THE PRODUCTION OF AVIATION FUEL



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sion ratios will rise and cooling systems will be improved. Small, air-cooled, airplane-type engines may power some cars. Fuel injection and supercharging may be used on truck and bus engines, though probably not on mass-production cars. But the changes will be gradual, not abrupt; and all signs point to the use of gasoline as fuel for most of our cars for years to come.

Engines and fuels have always developed along parallel lines. You can't get miraculous performance from a 1940 car simply by putting 100-octane fuel in its tank; nor can you adequately power a Thunderbolt with the 75-octane automobile gasoline of 1940. The fuel must fit the engine.

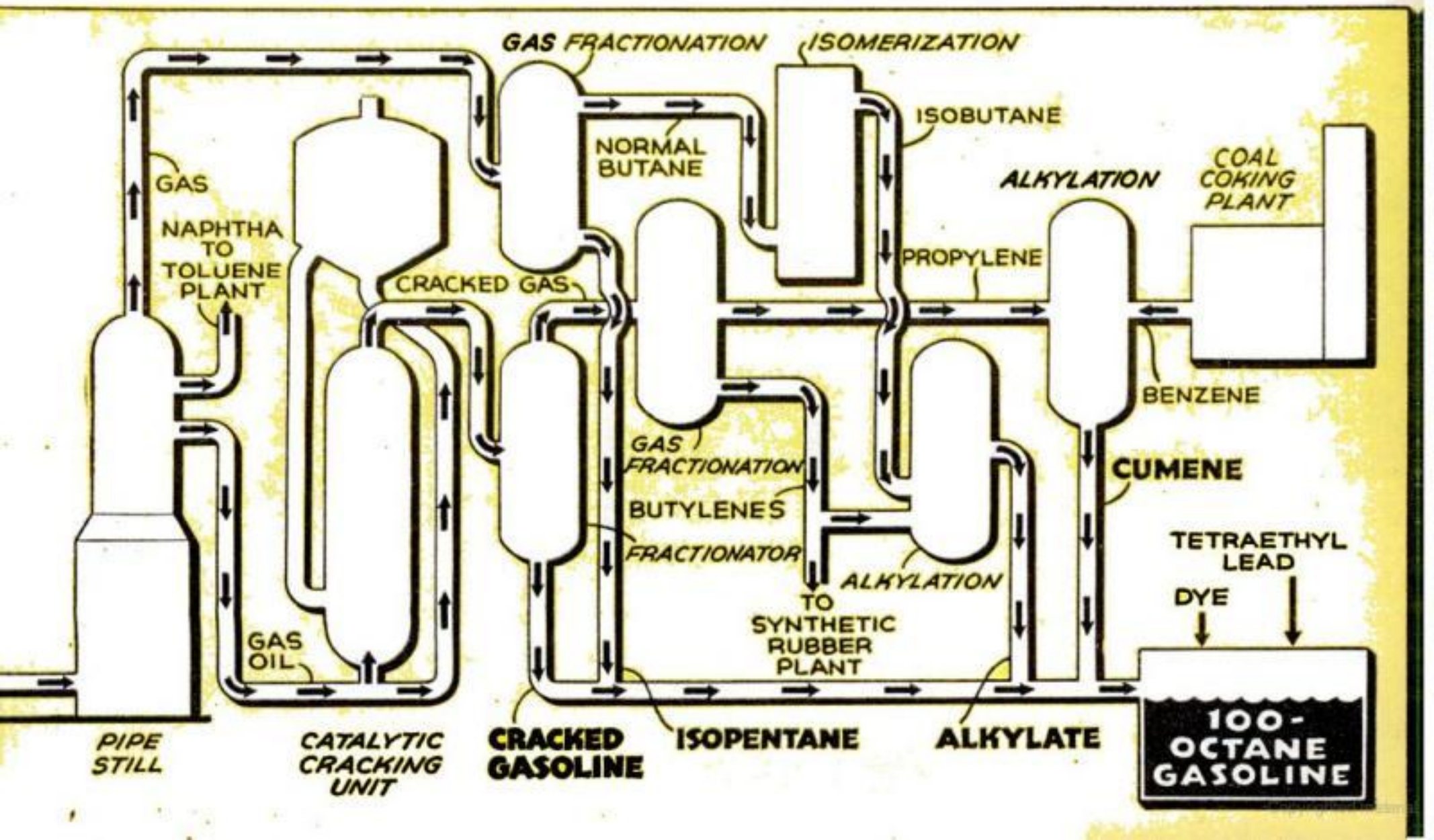
A gasoline engine gets its power from the controlled combustion of its fuel mixture between the piston and the cylinder head. If the fuel is suited to its compression ratio, the explosion travels like a wave of flame from the spark plug toward the piston, building up pressure as it travels. The more the fuel is compressed, and the more fuel there is under compression, the more powerful the explosion; hence the high-compression engine. But under high compression the fuel farthest from the spark plug tends to explode ahead of its turn in a violent detonation which wracks the engine instead of giving useful power. What happens is that the flame front boosts the already high pressure and temperature to which the unburned fuel is subjected, until finally it detonates—producing the familiar, wasteful, and—in airplane engines—dangerous knock.

The late Dr. Thomas Midgley discovered in 1922 that the adding of a little tetraethyl lead to gasoline greatly reduced its tendency to detonate. This spurred research in petroleum chemistry, and in 1926 Dr. Graham Edgar turned up a pure hydrocarbon called iso-octane which would not detonate in the highest-compression engines then available. Iso-octane was then too expensive to use even as a blending agent, but the engineers used it to establish the octane scale for rating gasoline. The scale was an arbitrary range between iso-octane, rated at 100, and normal heptane, which knocked under almost any condition and was rated at 0. The 68 to 70-octane gasoline you get at the filling station today performs about the same as a mixture of 70 percent iso-octane and 30 percent normal heptane would perform.

Edgar's iso-octane discovery was one of a whole series of findings. Crude oils contain many different combinations of hydrogen and carbon, known chemically as hydrocarbons. Only a few of them give high power and antiknock performance in an internal combustion engine, but the chemists and engineers found ways to change scores of undesirable hydrocarbons into those they needed. Using heat, pressure, and catalysts, they developed such basic processes as these:

Hydrogenation (1928) which adds hydrogen atoms to hydrocarbon molecules. Hydrogenation made possible the commercial production of synthetic iso-octane as a blending agent.

Catalytic cracking (1936) which breaks down big, heavy-oil molecules into smaller gasoline molecules. This improved cracking process materially increased the yield of



gasoline coming from a barrel of crude oil.

Alkylation (1938) which combines two different types of hydrocarbons into a new type. Alkylation provided a more efficient means of making synthetic iso-octane and other blending agents.

Isomerization (1940) which rearranges the atoms in a hydrocarbon molecule. By isomerization, butane and other unsuitable refinery gases are converted into raw materials for iso-octane.

With their new knowledge and processes, the oil men were now making engine fuels to order, much as a pharmacist might make up a prescription. They were taking what they needed from various types of crude oil, blending them in exact proportions, adding tetraethyl lead, and producing a new kind of gasoline. When war came and we needed a superfuel for our planes, they produced it.

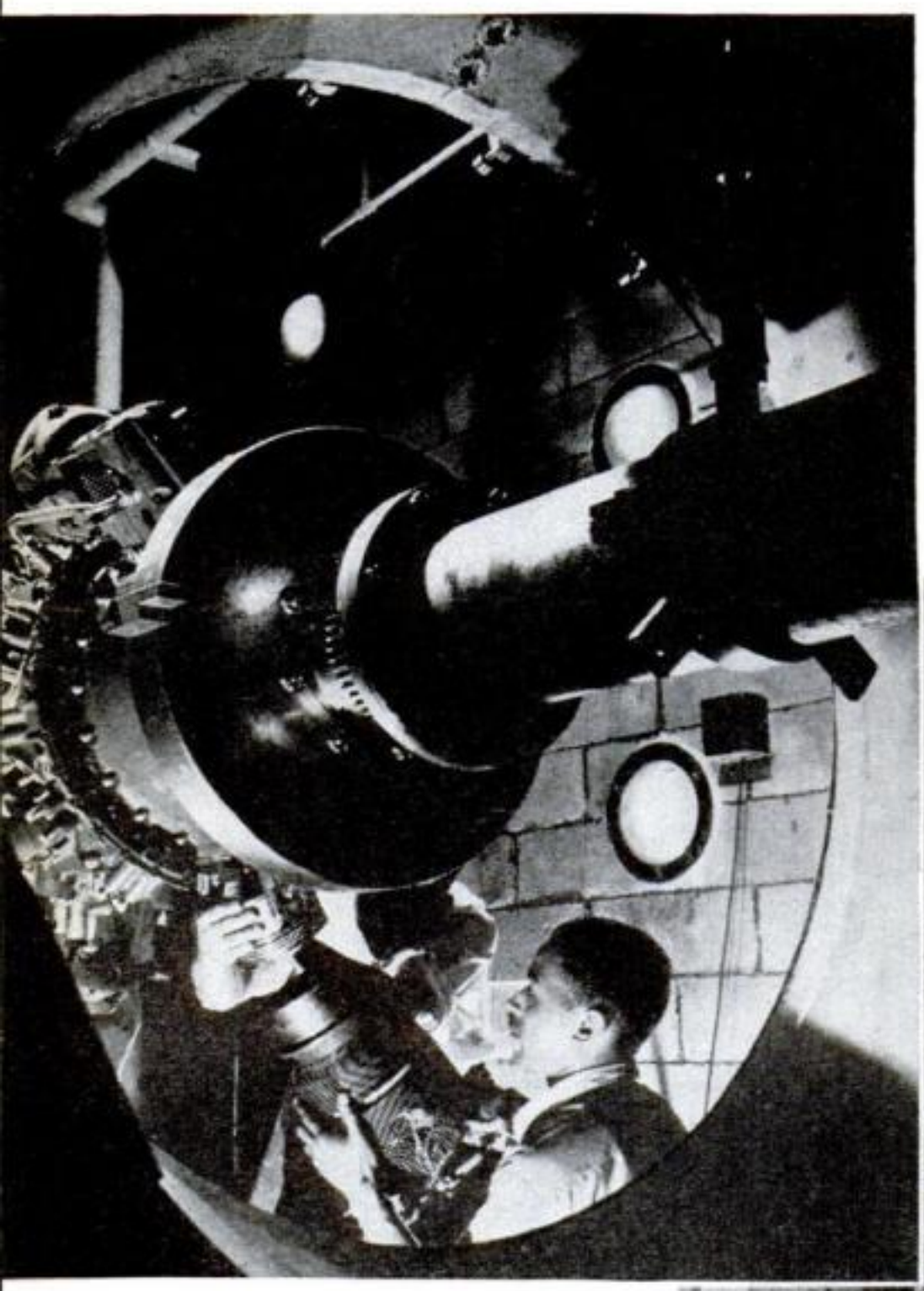
Many of their blending agents were expensive to produce, and about a third more crude oil is needed to make the same quantity of 100-octane gasoline as of 80-octane fuel, but for military use cost is a secondary factor; performance comes first. One typical aviation fuel blend, contents and percentages approximate, follows:

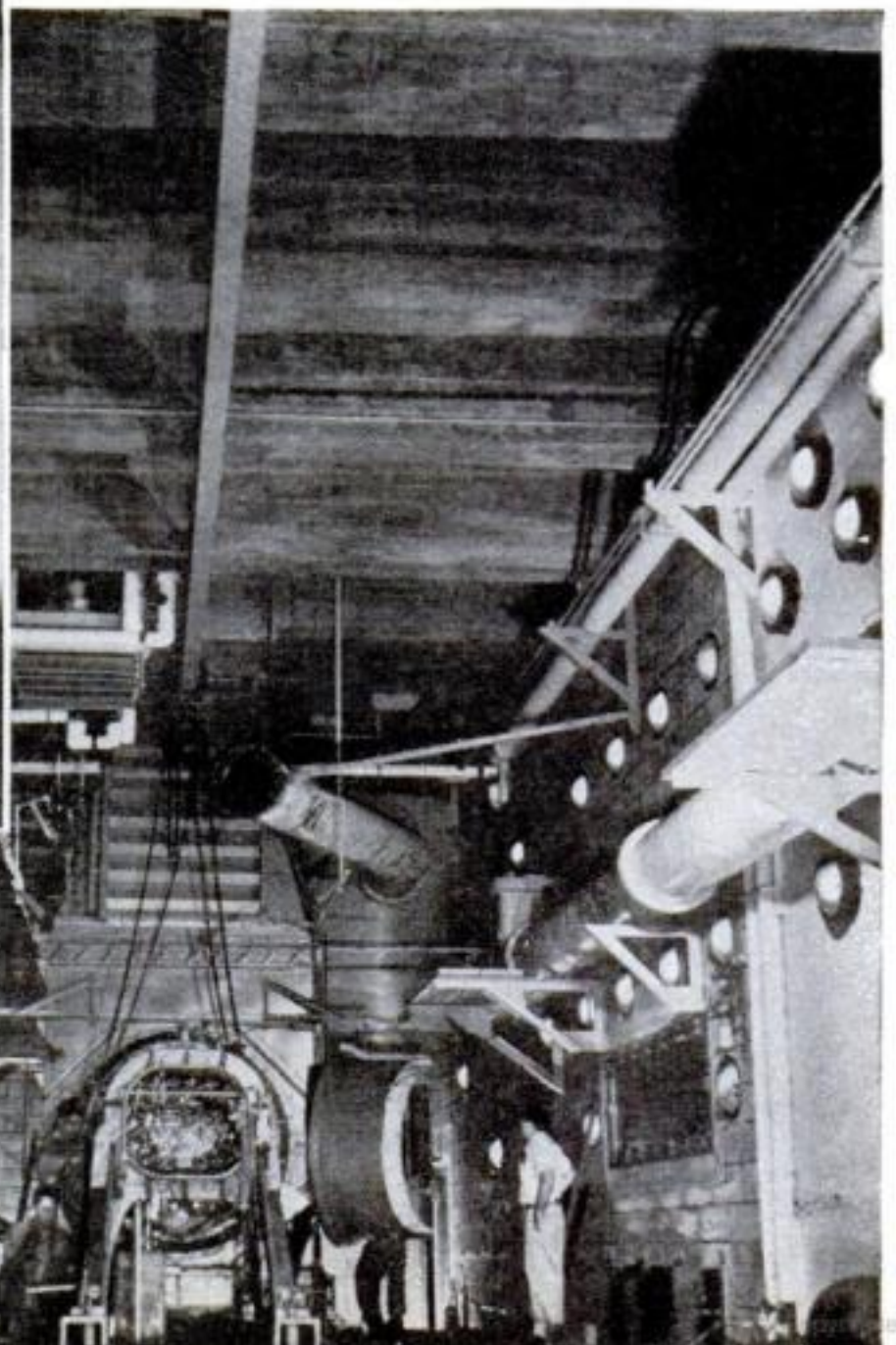
Catalytic-cracked gasoline, 80-82 octane	54%
Isopentane, 90 octane	8%
Iso-octane (alkylate), 92-95 octane	30%
Cumene (aromatic), 100 octane	8%

Tetraethyl lead, 4.6 cc. per gal.

The lead boosts the performance of all agents in the blend and gives the finished fuel approximately 100-octane rating. The alkylate is used for good lean-mixture properties, the aromatic for rich-mixture performance such as on the takeoff, the isopentane for high vapor pressure or easy starting. This fuel blend costs about 4 cents a gallon more to make than a 90-octane blend, 5 cents more than an 85-octane fuel. For peacetime aviation it might not justify its extra cost because it is only about 5 percent more efficient than 90-octane fuel for cruising. Its military value lies in extra power output at high speed and under heavy load.

One cost factor is the use of aromatics. Aromatic hydrocarbons occur in many forms in nature. One form occurs in camphor, another in





Elaborate test cells like this have aided petroleum engineers in blending high-performance aviation fuels. At right, an engine is being mounted in a cell having 16" concrete walls for protection in destructive tests. Above, an engine is readied for a run

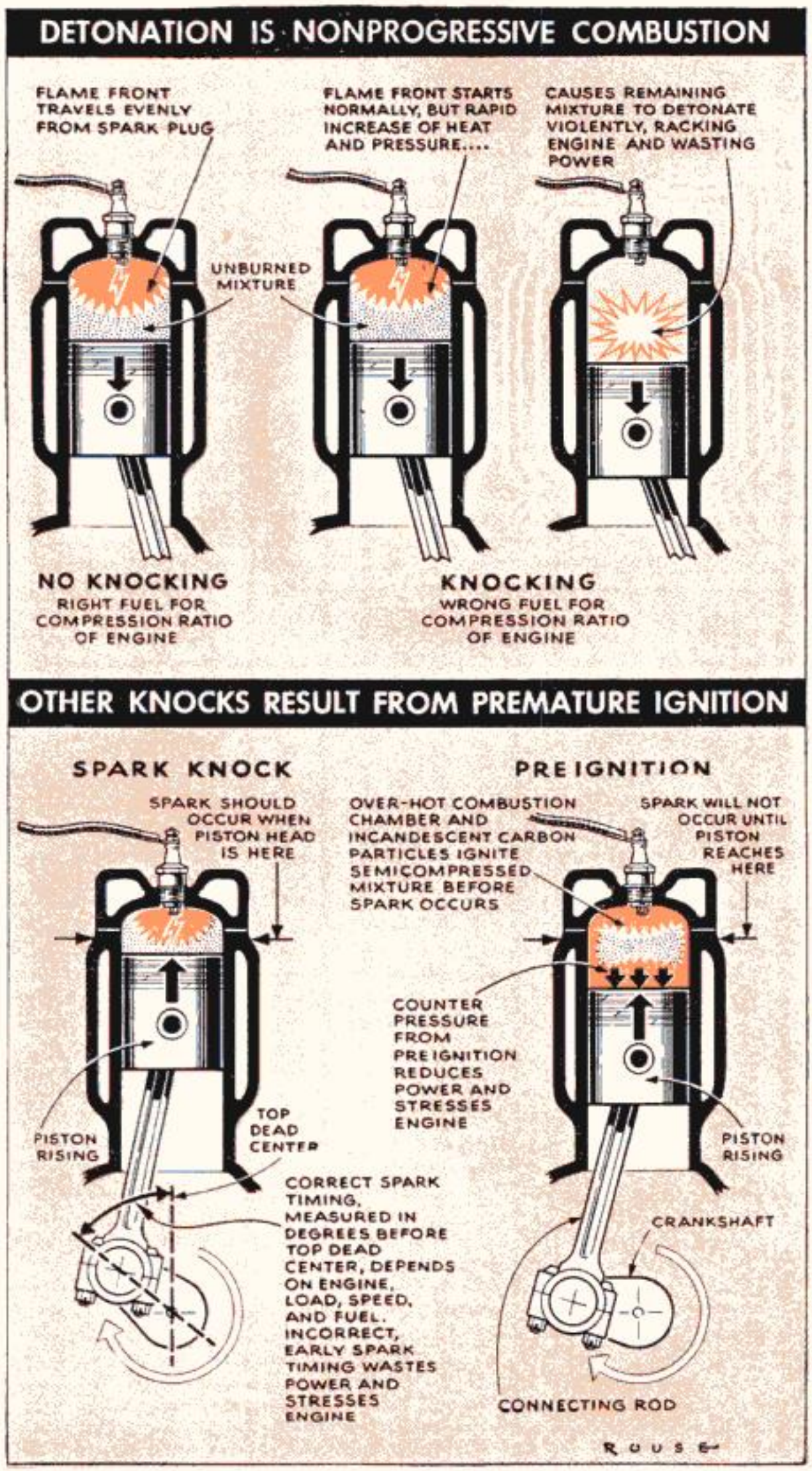
cloves; hence the name aromatic. Other forms occur as benzene and toluene, found in coal tar and some petroleums, chiefly those from the East Indies. Once recovered chiefly from coke gases, benzene and toluene can now be synthesized from domestic petroleum. But the process is costly, and we need toluene to make explosives, benzene to make artificial rubber. No great quantity of the aromatics is left for gasoline, to which they do almost magical things. Postwar research may find new wonders in the field of aromatic hydrocarbons.

The various basic processes for making gasoline from crude oil vary in cost and efficiency. The cheapest is ordinary heat-and-pressure cracking, which for years produced the bulk of the motorist's fuel. It produces about 45 barrels of gasoline from 100 barrels of crude. Catalytic cracking combined with polymerization costs more but produces 65 or 70 barrels from the some amount of crude. Hydrogenation and alkylation cost still more but produce as much as 110 barrels of gasoline from 100 barrels of crude.

The end of the war will find the petroleum industry equipped to produce considerably more alkylate than is needed for postwar aviation gasoline. Plants now producing aromatics for rubber and explosives will probably be available. War-accelerated research undoubtedly will offer improved processes for making automotive gasoline.

But it won't be high-octane gasoline, 100-octane or better. Such fuel is no more efficient, and may be even less efficient, in moderate-compression engines than 85 or 90-octane fuel. The latest engines on the road today, in 1942-model cars, have a compression ratio of only about 6.75 to 1, well below aircraft-engine ratios. Any sharp increase in compression ratios for automobile engines will call for redesigned engines with stronger pistons, rods, and crankshafts, better bearings and valves, better cooling of both oil and coolant, and probably a new ignition system. These changes will be made, but not overnight.

Tests have been made on conventional engines with jacked-up compression. Compressions above 8 to 1 caused L-head en-



gines to fail, with cracked pistons, broken crankshafts, excessive valve and cylinder wear. Overhead-valve engines worked at compressions as high as 10 to 1 and when properly geared for high-speed performance showed economy with 95-octane fuel. A modified Buick, engine modifications unspecified, ran 40 miles to the gallon on 100-octane fuel.

Engineers have learned a great deal about engine performance during the war. But changes will come only by degrees. Competition, particularly from newcomers in the automotive field, will accelerate change, and older companies will have to keep pace. Nevertheless, it is now taken for granted that the first postwar models will be substantially the same as those of 1942.

Stronger, lighter alloys will be used, not only in the engines but thoughout the cars of tomorrow; but car sizes probably will not be much reduced. We like our cars comfortably spacious. Smaller engines may be used. As compression ratios rise, engines will be more compact; the extreme strain on the crankshaft may rule out long engines such as the straight eight. We may have sealed cooling systems using new coolants. Some form of radiation cooling for the oil will come, because high compressions develop greater heat and oil coolers are an efficient way of controlling it.

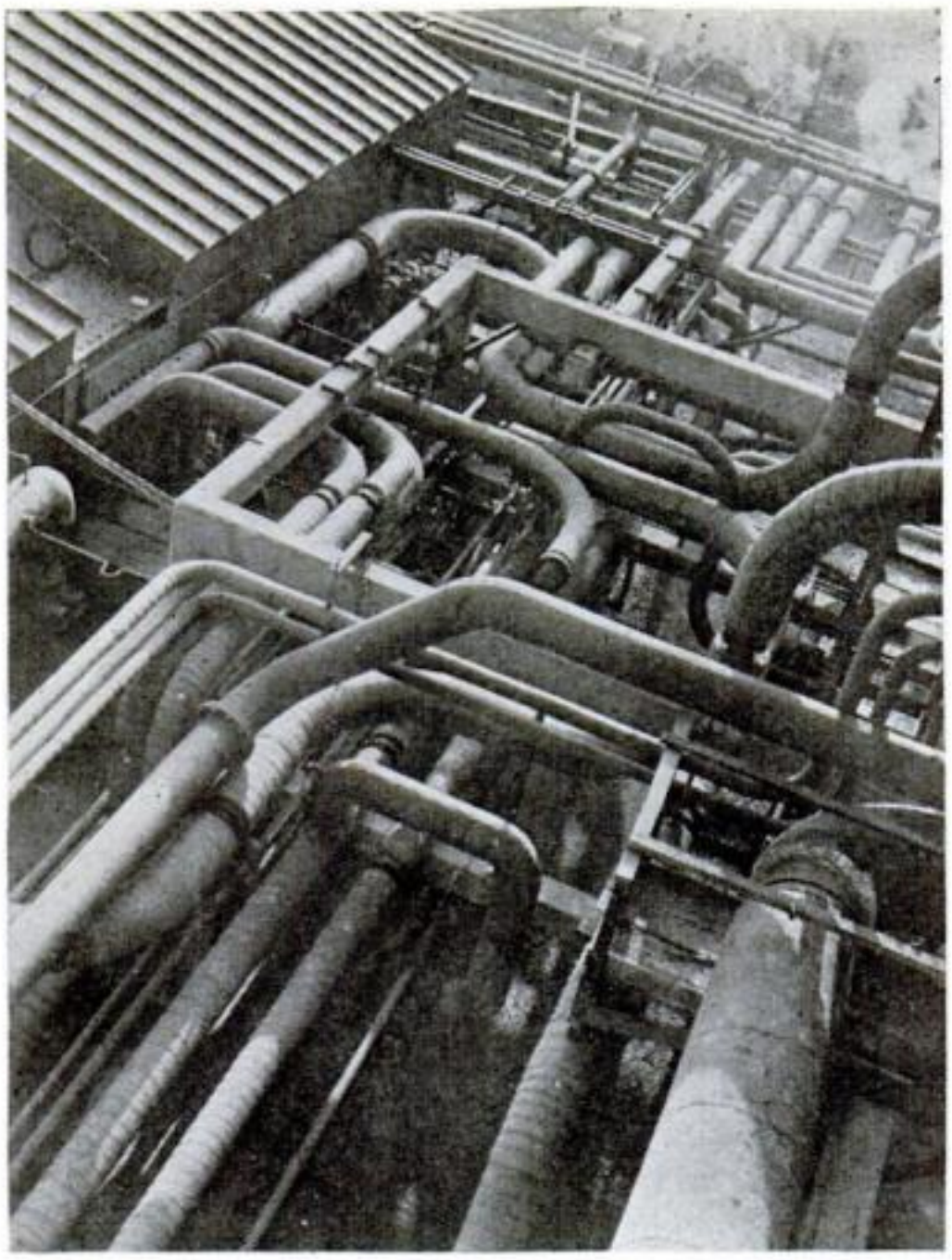
Aircraft experience will lead to better valves, bearings, and piston rings. Better ignition will come; it has been suggested that vacuum tubes may replace our present distributors. The combustion chamber probably will be redesigned to minimize preignition. Automatic transmissions undoubtedly will receive a good deal of attention, particularly if they can be designed to use the greater economy and power of high engine speeds.

There seems little likelihood that other fuels will replace gasoline in the immediate future. The Diesel engine has made a place for itself in heavy-duty operation, but it is still too heavy and finicky for pleasure-car use. Alcohol never was a satisfactory or efficient fuel for internal-combustion engines. The various gases used in European cars are cumbersome to handle and inefficient; anyway, the best of them can now be converted, by the refiners' magic, into elements of blended gasoline, which still packs more power into a small space than any other reasonably priced fuel known.

Public acceptance probably stands at the head of any list of factors which will influence the speed and degree of change in postwar automobiles. New engines must be simple and highly dependable. They must be economical, for mass sales. First cost as well as upkeep will be an important factor. This will limit "gadgetry" and, to some extent, the use of expensive new materials.

Finally, there will be the pressure of the fuel makers, whose visions of the future automobile are already more advanced than those of the motor makers. They have a superpremium fuel and they tend to think of the immediate future in terms of the superengines in our war planes. The motor men are thinking in terms of the automotive engines they know so well, and of the public which will be buying and driving tomorrow's cars. They think in terms of consumer acceptance and mass production. Somewhere between these two sets of visions lie our postwar automobiles.

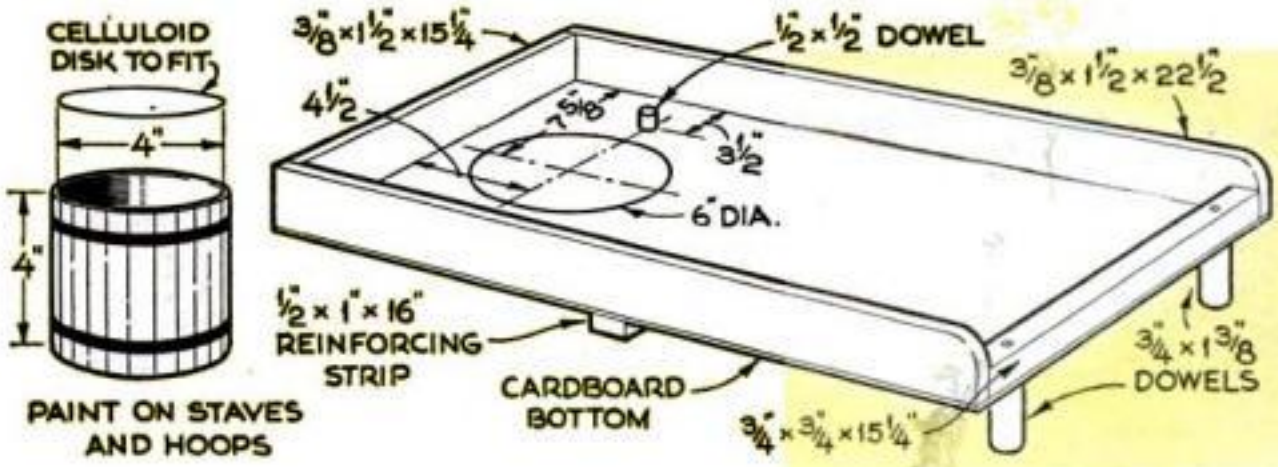
They will be new cars, better, lighter, more efficient cars. But they will not be P-51's roaring down highways on four wheels at 125 miles an hour. And they will be burning gasoline blended and leaded to around 90-octane, perhaps as high as 95 in another ten years.

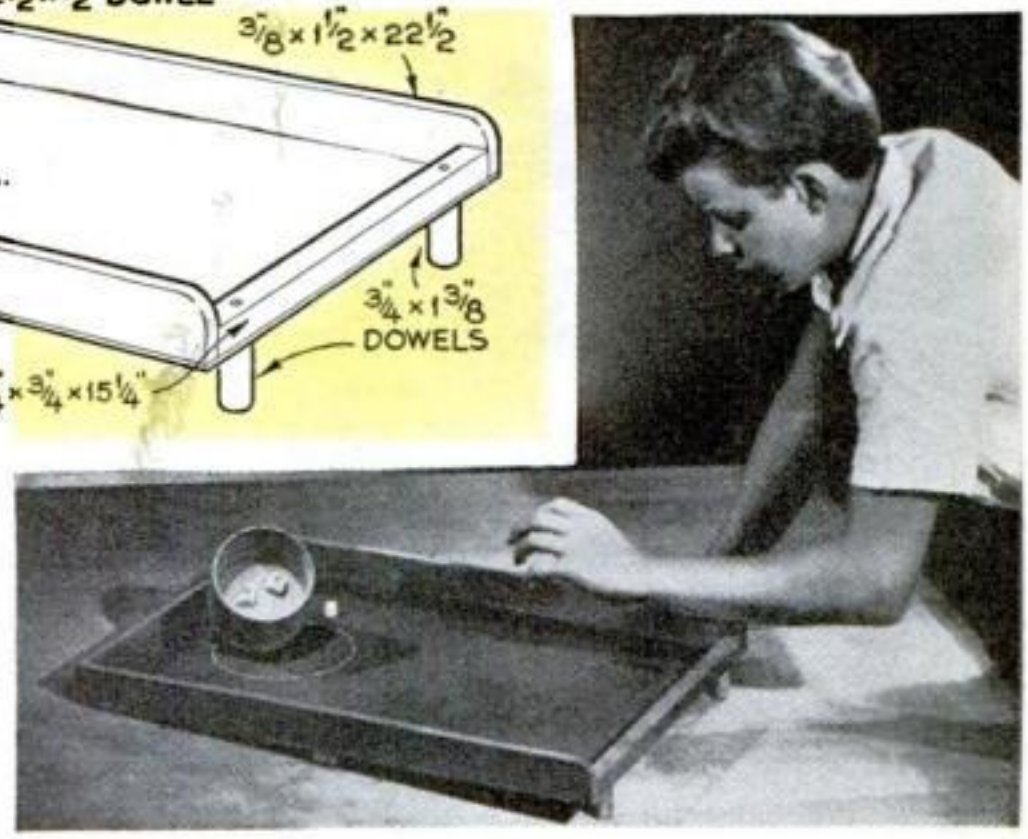


This pipe maze symbolizes the intricacy of a modern refinery

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Rollicking Barrel-Rolling Game Has Novel Scoring Action

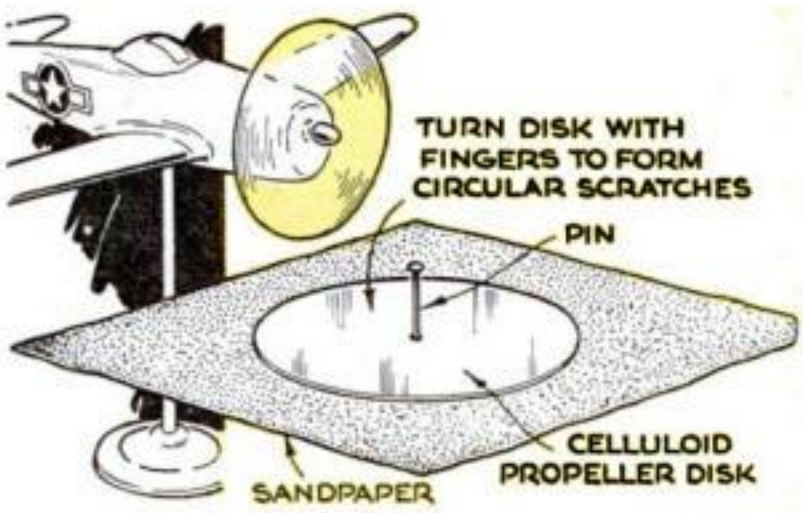




WITH half of an empty cereal box and a few pieces of wood, you can build a game that will be a barrel of fun. Cut out a ¾" thick hardwood disk to weight the bottom of the box, and cut out a celluloid top. Paint the box with staves and hoops to resemble a barrel, using a bright color for the inside. Then cut two scoring cubes of hardwood, bevel the edges, and number the sides from one to six, or buy a large pair of dice. Put them in the "barrel" and cement on the celluloid top.

To play, lay the barrel on the starting strip and let it roll down the board so it will strike the peg and be thrown upright. Count as a score the numbers showing on the tops of the cubes. Each player has three rolls. He scores double for any in which the barrel stops in the circle. The highest total score wins.—MYRON FLEISHMAN.

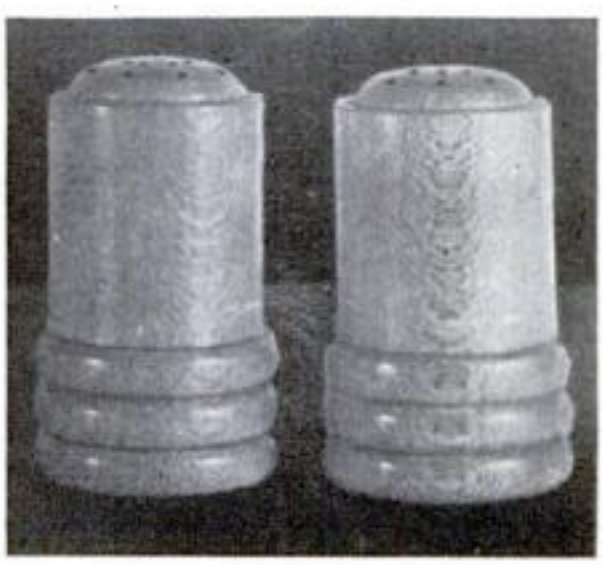
Disk Propeller of Celluloid Appears to Spin on Model Plane



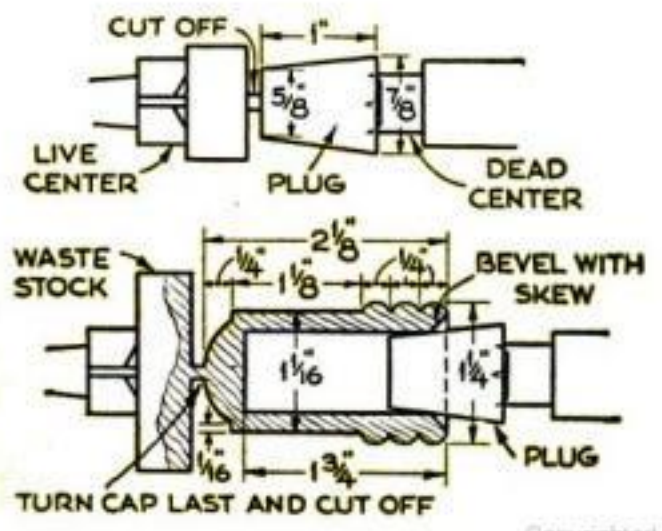
SCALE model planes of the solid type gain a more realistic appearance when fitted with celluloid-disk propellers that seem to be whirling. Scribe with dividers on medium-weight celluloid a circle of the size of the propeller. If the material is scored deeply, the disk can be torn out cleanly along the scribed line.

To get the "spin," lay the disk on a sheet of medium sandpaper, drive a pin through the center for a pivot, and turn the disk with some pressure. The circular scratches give the illusion of action when the propeller is mounted on a well-made model plane.

Modern Pepper and Salt Shakers Are Simple Lathe Project



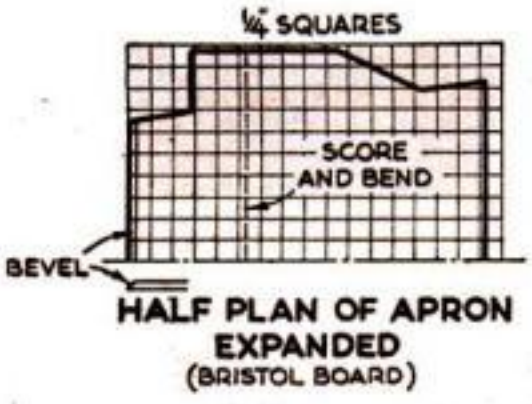
MAPLE was used for the shakers shown, but nicely grained hardwood that matches your dining-room furniture will be ideal. Bore the ¾" hole first in a 2¾" length of 1¾" square stock. Turn the plug next; then use it for a dead center and turn the shaker. Sand smooth and finish with clear lacquer or varnish rubbed with pumice and oil. Drill the holes with a thin brad for pepper, a thick one for salt.—N. S.



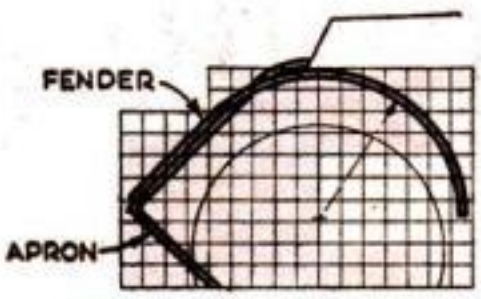
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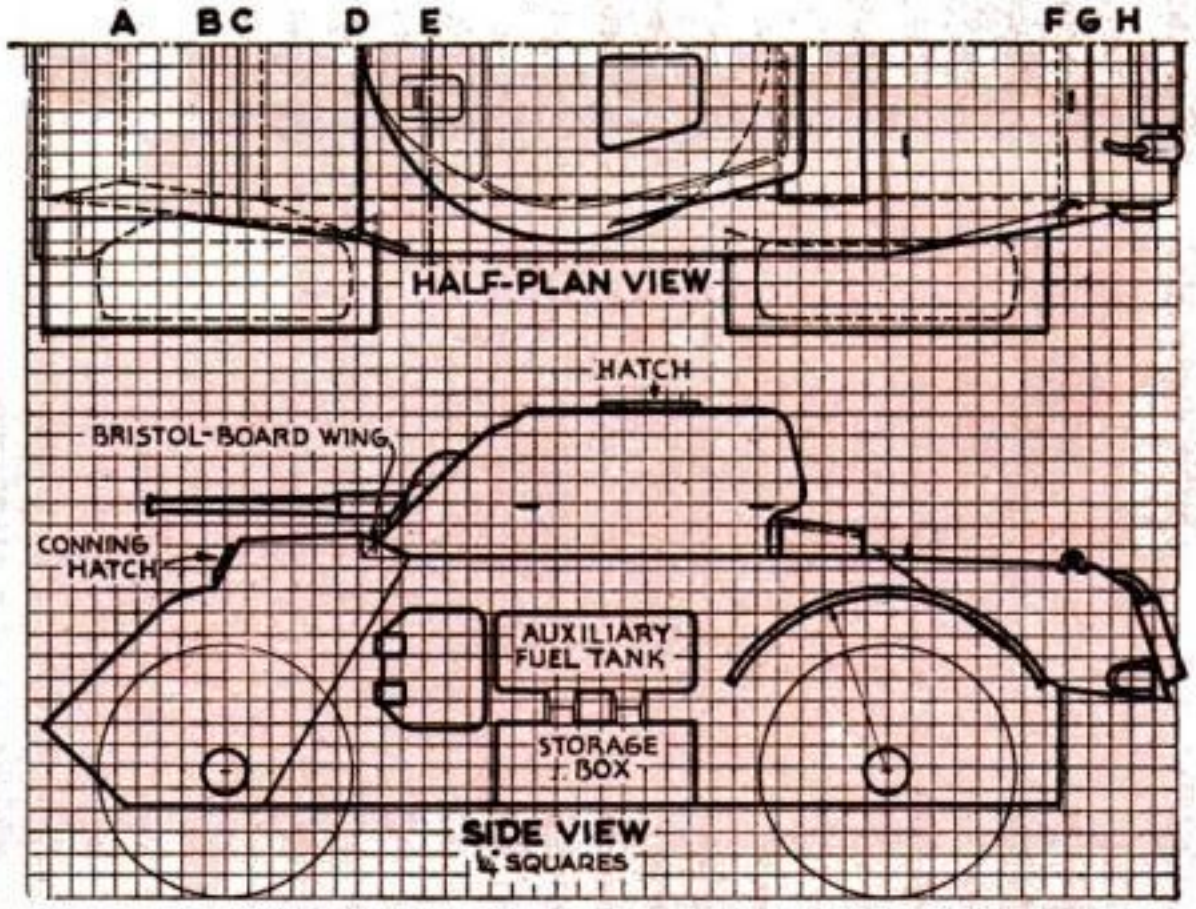
Either mud-and-snow or highway treads may be used on the Staghound, which can ford sizable streams

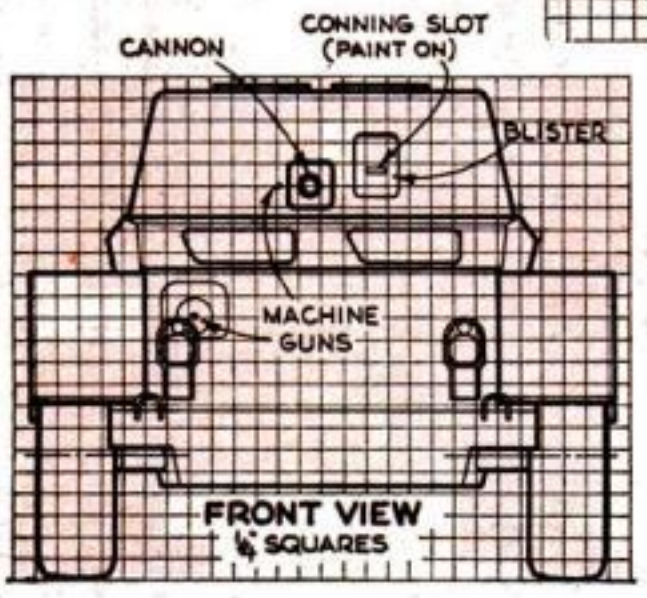


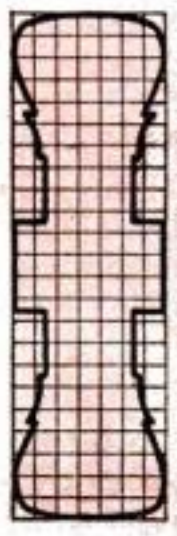
HALF PLAN OF APRON EXPANDED
(BRISTOL BOARD)



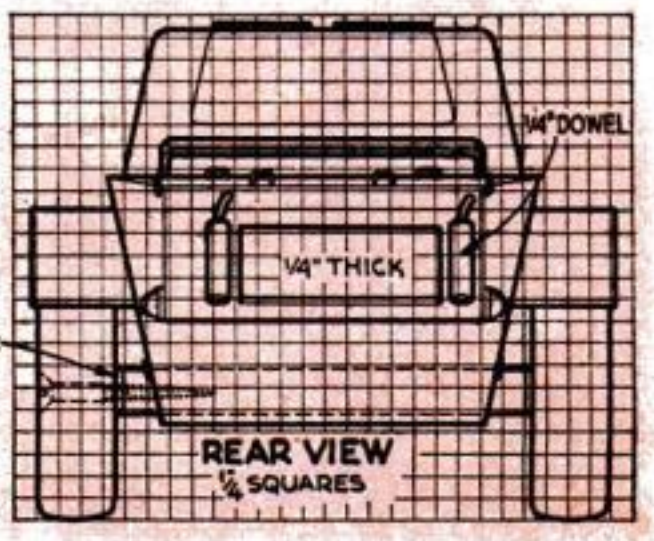
FRONT FENDER AND APRON
¼" SQUARES







WHEEL SECTION
⅛" SQUARES



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SCALE MODEL OF THE BRITISH STAGHOUND

Now Spearheading Allied Advances in Europe, this American-Made Armored Car Was Until Recently a Guarded Military Secret

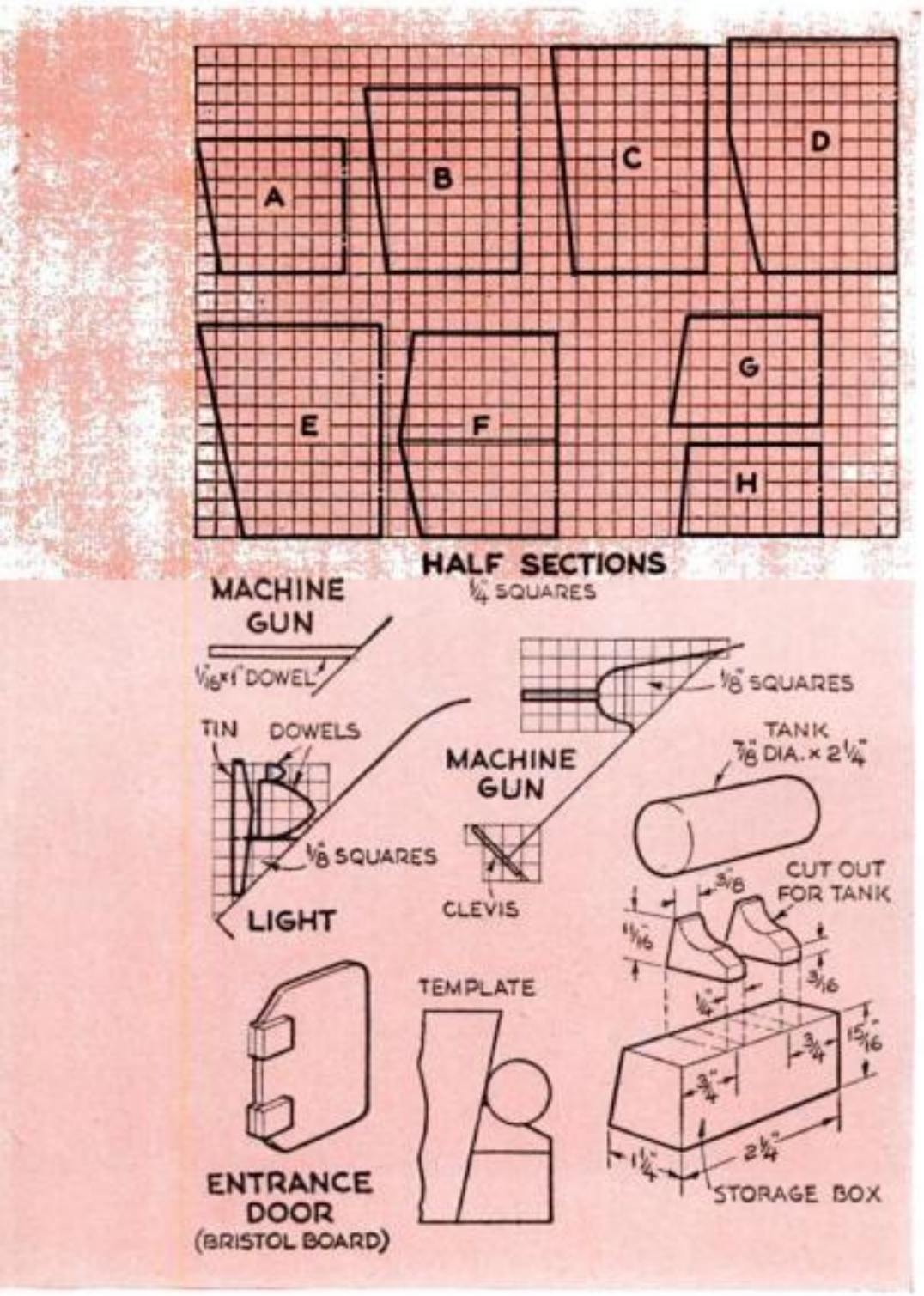
By JOHN G. KINGDON

ONE day last fall a group of British infantrymen was lying alongside a road near a small Dutch city. The Nazis had a machine-gun nest up ahead. Every time a Tommy stuck his head up, puffs of dust raised by murderous enemy bullets came marching across the road toward him.

Usually when an infantry unit is pinned down in this manner, it dispatches a patrol to attempt to wipe out the nest—exceedingly dangerous work under the best of conditions. But the British commander had a better idea. He turned to a portable radio and spoke briefly into it.

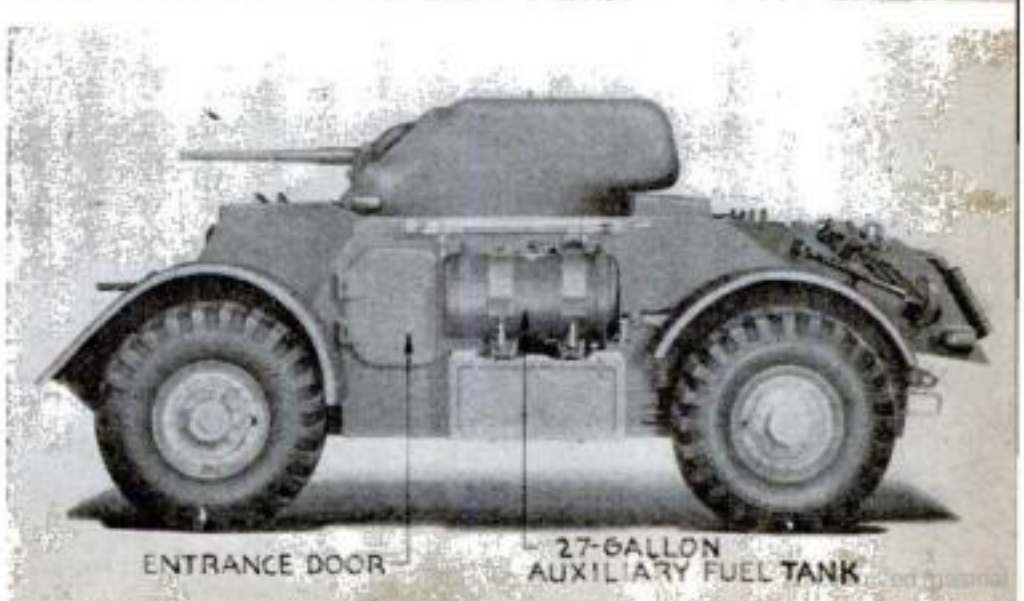
In a few minutes an odd-looking vehicle rolled up at a speed comparable to that of a passenger car. Its angular, squat body was set on four tremendous wheels—each almost 4′ in diameter—and surmounted by a turret from which protruded a cannon and a machine gun. Pausing just long enough to gets its bearings, it swept onward. The German gun chattered like an angry squirrel and a hail of bullets clanged ineffectively against the heavily armor-plated body. In reply, the car began spitting tracers from the turret-mounted machine gun. The white-hot barbs moved about a bit as the gunner adjusted his aim; then pumped steadily into the enemy position. The gunner pushed a button and the cannon —which had been moving automatically as the machine gun moved—boomed mightily. The Nazi emplacement disappeared in a hail of debris.

So ended an episode in the thrilling story that the formidable American-built Staghounds are writing. Made by Chevrolet, the



Although it carries more armament, the Staghound resembles the American M-8 armored car, which has a 37-mm. cannon, and the M-20 high-speed armored utility car, which mounts a .50-cal. machine gun. The photos of the Staghound below show numerous details that will be of help to the modelmaker





Staghound—a high speed combination tank and reconnaissance car with four-wheel drive—was first produced in 1942, but only recently has it been taken off the secret list.

It weighs 14 tons and carries a five-man crew. Two auxiliary fuel tanks give it an extensive cruising range. Armament and equipment include the 37-mm. cannon with its tracer-firing machine gun, two-way radio, a .30-cal. machine gun, a submachine gun, hand grenades, a steering-and-gun-sighting periscope for use when the hatches are shut, an intercommunication phone, a fire-extinguisher system, and a searchlight with a flasher attachment for signaling.

Besides eliminating machine-gun nests, the Staghound can wipe out any type of light-weapon emplacement, locate and blast groups of snipers, augment infantry attacks, menace enemy supply lines, patrol occupied areas, and lay protective smoke screens.

The model is made from Bristol board, close-grained wood such as white pine, and paper-clip wire. Lay out a grid of ¼" squares on a piece of cardboard; by matching squares, tranfer the half sections to this piece; then cut away the excess material to form templates. Using these as guides, carve the body from a solid block of wood. Drill two holes through the block at the indicated points to take ½" by 4 9/16" dowel axles. Drive the axles into place and secure them with glue.

Using the screw center on your lathe, turn four wheels. Fasten them to the axles with 2" wood screws and 1/16" by ½" dia. washers. Lay the apron out on a piece of Bristol board and cut it to size. Score and bend it as indicated and glue it to the body. The over-all width, from outside edge to outside edge of each pair of Bristol-board fenders, is 6⅝". Bend the front fenders to a radius of 1⅝" and sand down the apron at the points where the fenders cross it. The radius to which the back fenders are bent is 2". Shape the inner edge of all four fenders to fit the body and glue in place.

Carve the turret from a block of wood and fasten it to the body with two screws located so they will be hidden by the turret-top hatches, which are made of Bristol board and glued to the turret. The blister and the cannon foundation are made from scraps of wood and glued to the turret face. The cannon is shaped from a ¼" dowel.

The storage boxes, tank foundations, and tanks are made from wood; the machine guns are 1/16" dowels; and the hatches, entrance doors, and rear-deck deflector are Bristol board. The front lights are carved from dowels, set on scrap-wood foundations, and protected by tin guards. The taillights are made by splitting a dowel into two pieces and shaping each piece; each light is glued to a Bristol-board foundation and each foundation is glued to the body. The exhaust silencers are lengths of ¼" doweling and have wire lead-in pipes. Make the assist handles and clevises from paper-clip wire.

Finish the completed model with brownish-gray camouflage paint.

Possessing unusual speed and mobility, the Staghound performs spectacularly on a variety of terrain



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GREAT-GRANDPA LIKED GADGETS TOO

Tricky Household Devices of the 1800's Display a Wealth of Homespun Ingenuity

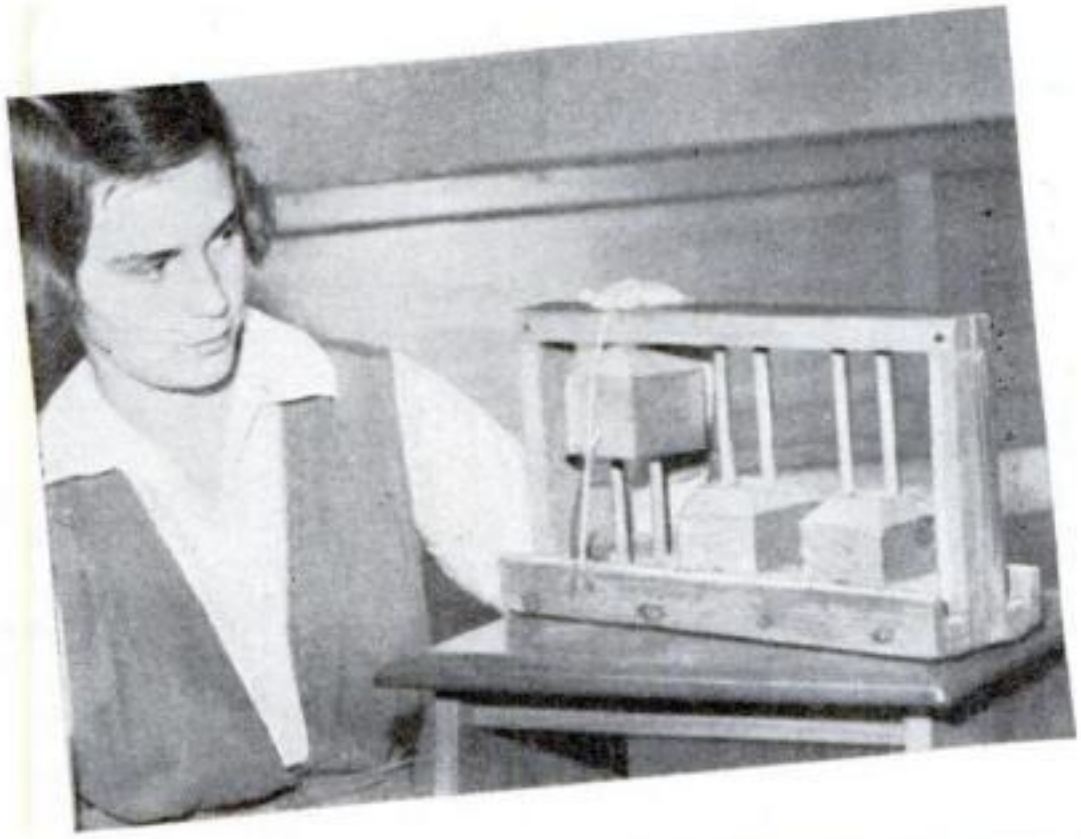


WHAT makes you think all the intricate gadgets and ingenious devices in your home are something new? Though he didn't have electricity, great-grandfather outfitted *his* house with the same kind of labor savers. Those shown here are from the collection of Bartlett Hayes, displayed at the Phillips Addison Gallery in Andover, Mass., and at the museum of the Rhode Island School of Design in Providence.

The world beat no path to his door when great-grandpa devised this mousetrap—and of strictly noncritical materials at that. Mice were caught by blocks when they gnawed on a string rubbed with bacon fat

Old-fashioned? Maybe; but this baby carriage was considered a very stylish rig back in the days when victorias were all the rage. Built in miniature, it closely followed the lines of those vehicles of the well-to-do



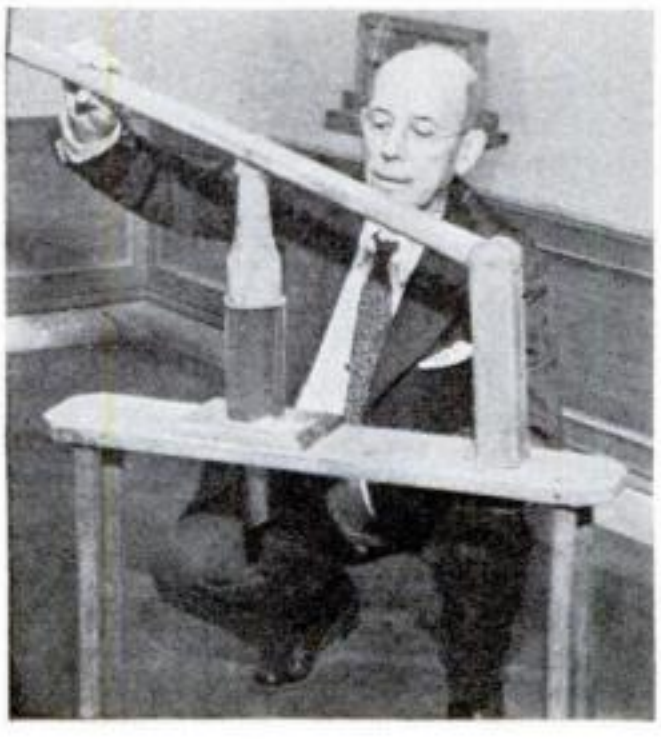


It was true yesterday as now that wash day could hold no terrors for the fortunate housewife who owned a washing machine. Worked by hand, this one did a good job



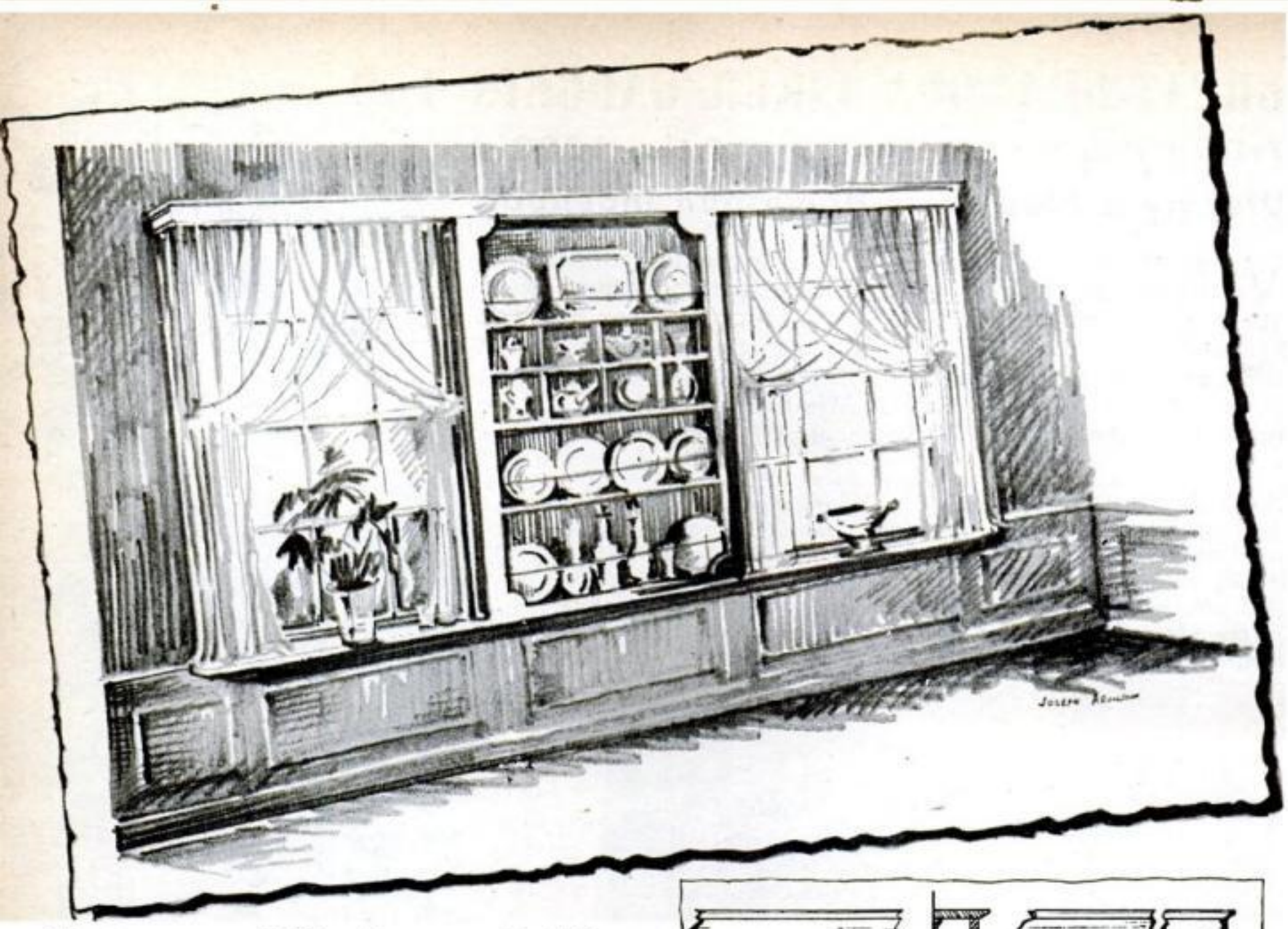


Sausage for dinner? Just set up your sausage-maker and go to it. The plunger forced the previously ground meat through a metal tube into the sausage casing beneath



Food chopping proved no big problem for great-grandma if she had one of these highly ingenious machines. A hand crank rotated a gear, which transmitted its motion to an oscillating beam that gave piston action to the knives

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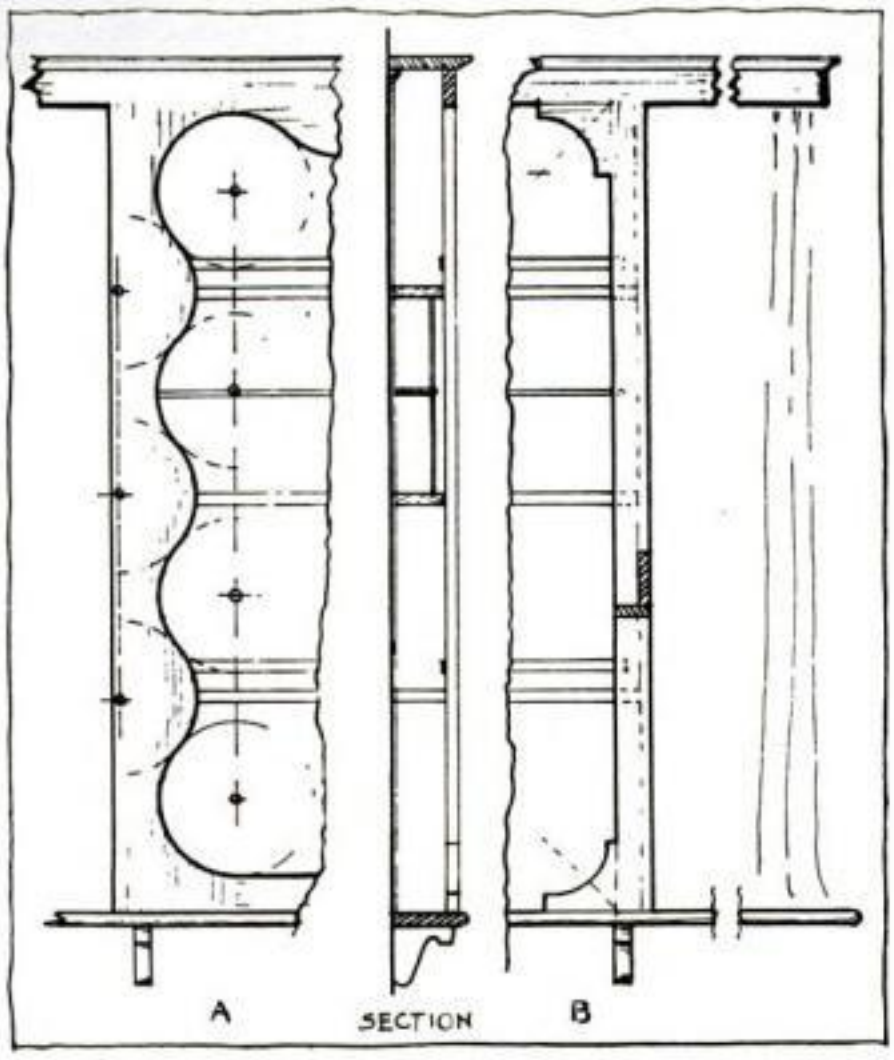
Between-Windows Cabinet Holds Fine China

By JOSEPH ARONSON

WHEN interior designers stress composition, they mean the arranging of small or separate elements into a harmonious grouping. Sometimes very diverse elements, such as two windows and a collection of glassware and china, can be brought together by tying in the curtain treatment and a display cabinet. The composition illustrated not only shows off such elements to advantage, but it may add greatly to the charm of the room.

Proportions, of course must be worked out from the height of the windows and the space between them. Take the cornice about 6″ past the outer casing of the windows, and keep the cabinet about the same distance in toward the center if there is room enough. The extended cabinet floor is set on the window sills and reaches about 8″ beyond the outer casings. Two of many possible designs for the uprights are shown at the right.

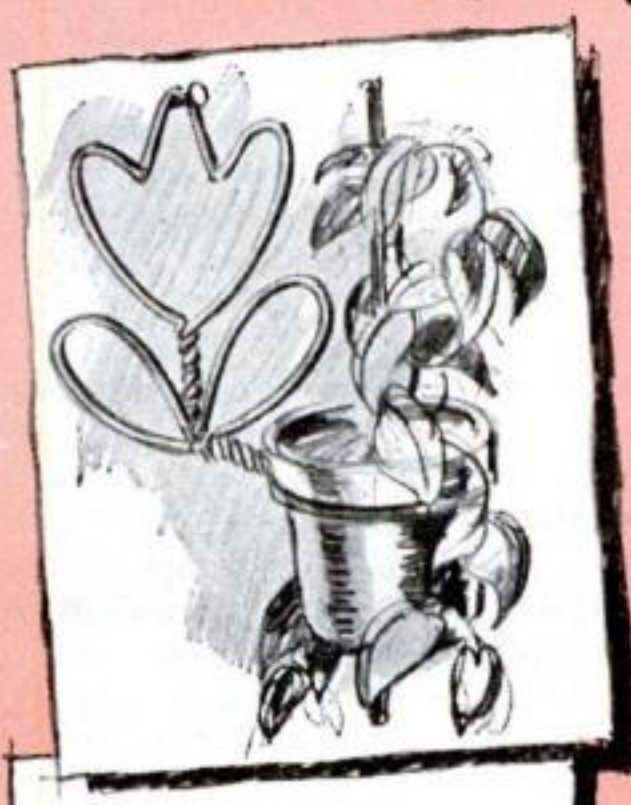
The back of the case may be treated as decoratively as desired. If your walls are painted in one color, try a small-patterned wallpaper or decorative paper or fabric. A solid background of a strong color, or even a mirror, will be effective if your walls are covered with a patterned paper. The mirror may be held in place by small quarter-round or cove moldings.



Clear shop pine ¾″ thick is the best material for all the parts. Little guard rails or bars to keep the china and glassware in position may be either ¼″ by ¾″ flat strips or ½″ dowels. Trim moldings can match those already used in the room, or they may follow the plan in the drawing. The final finish, except for the interior, should conform to the other trim in the room.

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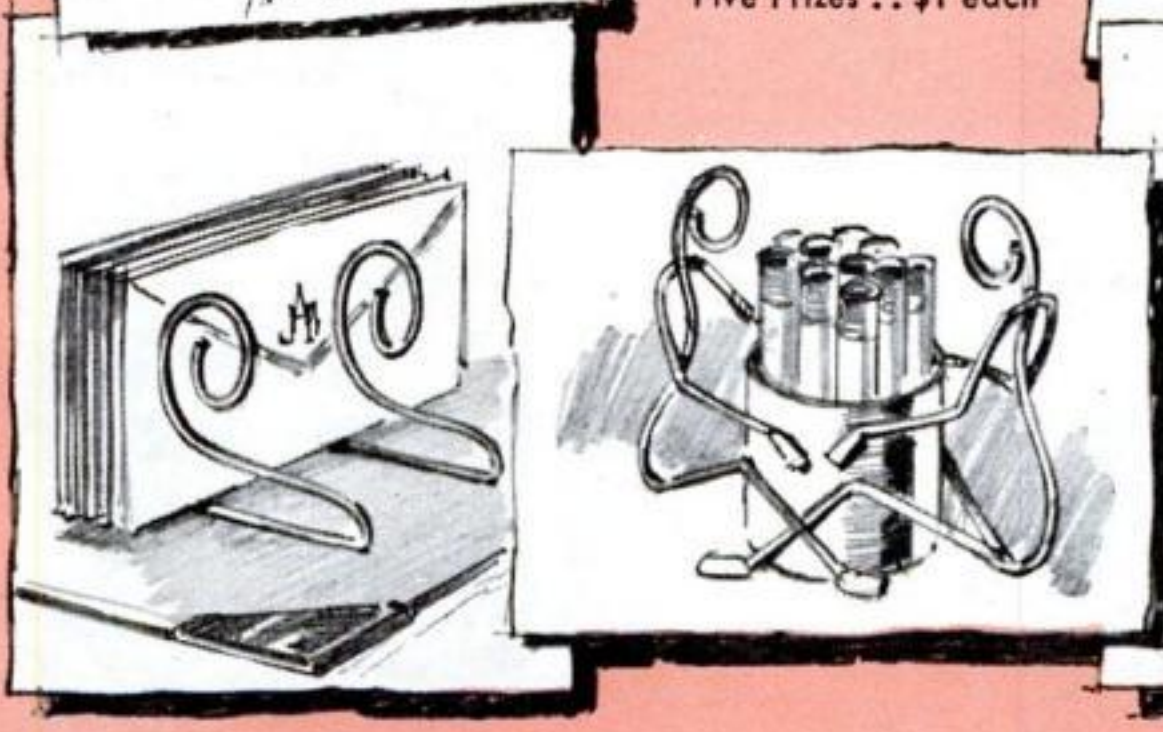
$50.00 in Prizes for Things Made of Wire



Wire is an easy material to work with. See what you can do, and send us your best project—either the piece itself or a good photo. It may be judged the winner of one of the following eight prizes:

1st Prize $25
2d Prize $15
3d Prize $5
Five Prizes . . $1 each





THIS is a contest that calls for some real ingenuity—the kind that most craftsmen love to display. Make your projects of any kind of wire; but here's a tip: coat-hanger wire is fairly rigid and yet is easy to bend and work with pliers.

To give you more latitude, one piece of material—but only one—may be used in addition to the wire.

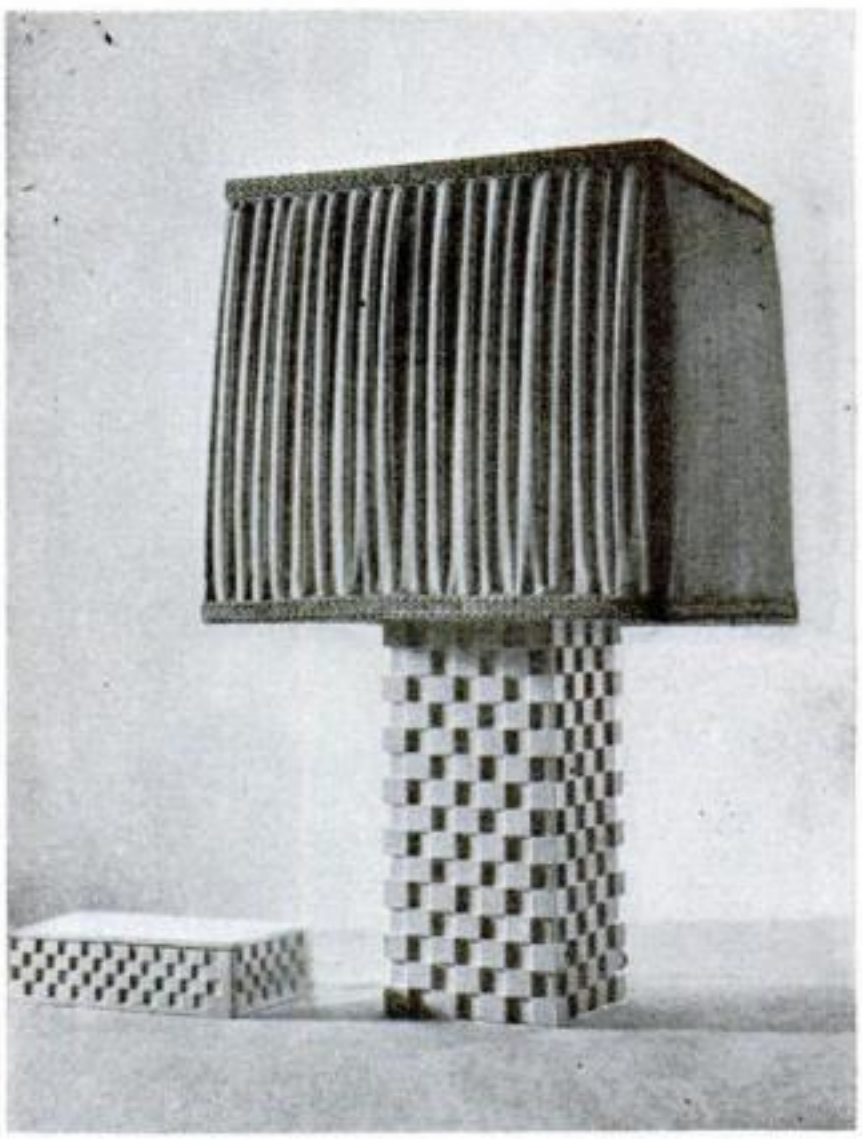
It may be a handle, such as that shown on the plate holder above, or a can, such as that for the cigarette box, or any other part. However, wire must constitute the chief part of the project—it must not be mere trimming for a project that is made essentially of something else.

Send entries or photographs, fully prepaid, to the Wire Contest Editor, POPULAR SCIENCE MONTHLY, 353 Fourth Avenue, New York 10, N. Y., to arrive on or before March 15, 1945. You may submit as many pieces as you please, but all entries from any one person will be judged as a group and will be eligible for only one prize. No entries will be returned.

The judges will be the editors of POPULAR SCIENCE, and their decision will be final. In case of ties, duplicate prizes will be awarded.

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BUILT-UP LAMP AND BOX SHOW



By Charles and Bertram Brownold

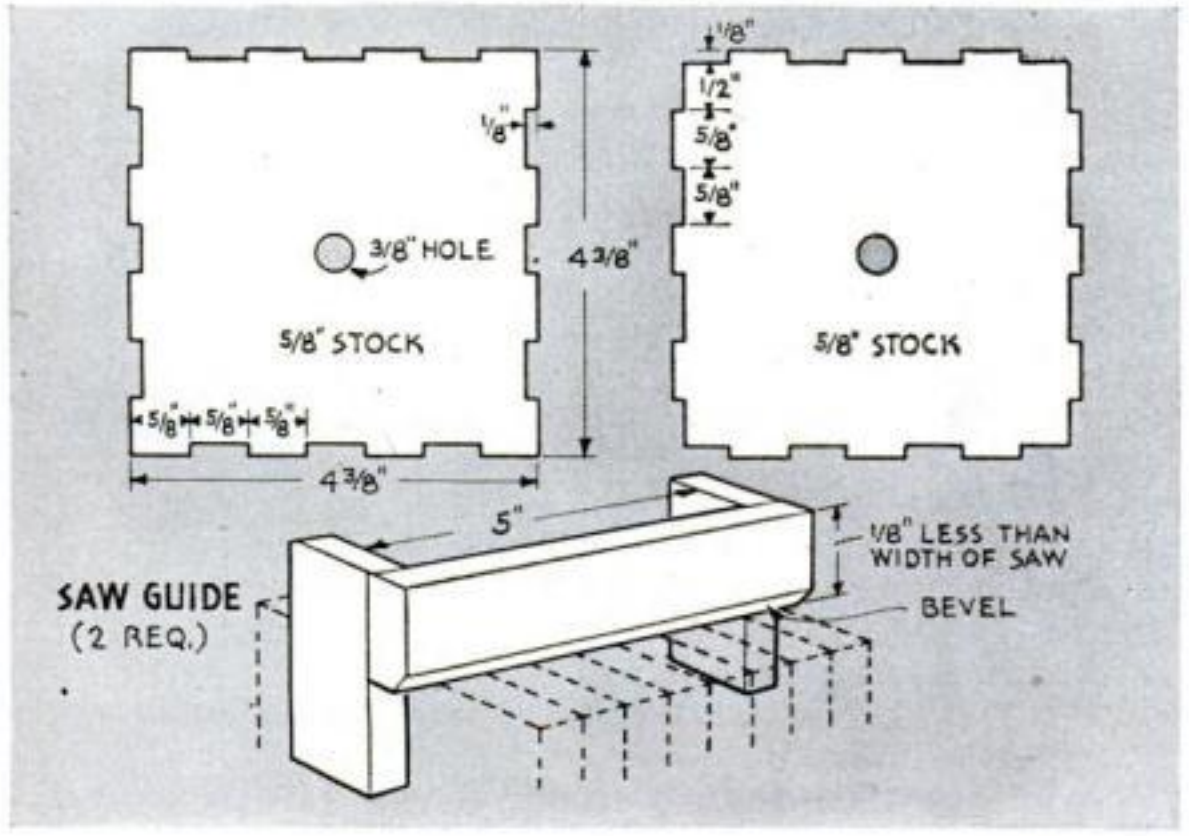
MATCHING lamp and cigarette-box sets are attractive and useful ornaments for a desk or table in the modern home. Despite the complicated carved effect presented by the lamp and box shown here, all the work is done with simple hand tools—a backsaw, a chisel, a hammer, and, of course, clamps. The checkerboard sides in relief are exceedingly easy to make, although the finished pattern appears, even on close inspection, to be impossible to achieve without intricate and painstaking carving.

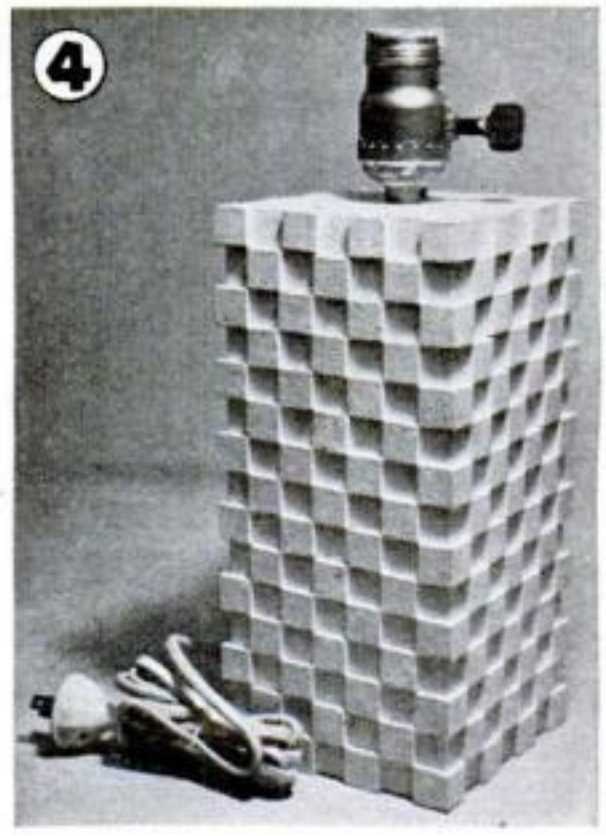
As shown in the drawings and photos, the secret lies simply in sawing and chiseling notches in a series of pieces and then assembling them so that the raised and chiseled squares alternate. For the lamp base this can be accomplished easily by stacking two sets of squares and notching one as shown at the left in the drawing and the other as shown at the right. Eight squares of one kind are used with seven of the other. A simple saw guide makes it











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DEEP CARVING EFFECT

easy to cut the notches uniformly.

This saw guide consists of two identical pieces clamped to the stacks as shown in Fig. 1. They are spaced to permit easy sliding of the saw blade and beveled at the bottom so as not to interfere with the saw teeth. The height specified enables them to be used as stops so the back of the saw will come to rest on the top and all cuts will be to a uniform depth of ⅛".

The dimensions given in the drawing are for ⅝" thick stock. If a different thickness is used, be sure the width of the notches is the same as this thickness so the finished notches will be square. Reclamp the stack for each saw cut, arranging the guides so the kerfs will be in the waste stock to be chiseled out. A strip the thickness of the saw kerf may be inserted to keep the pieces aligned when reclamping. In notching the seven pieces, add an eighth piece to build up the stack to the width of the saw jig. After completing all cuts, clamp each stack again and chisel out the waste, being careful not to split the end pieces. Then, with sandpaper glued to a block, as in Fig. 2, sand the notches smooth.

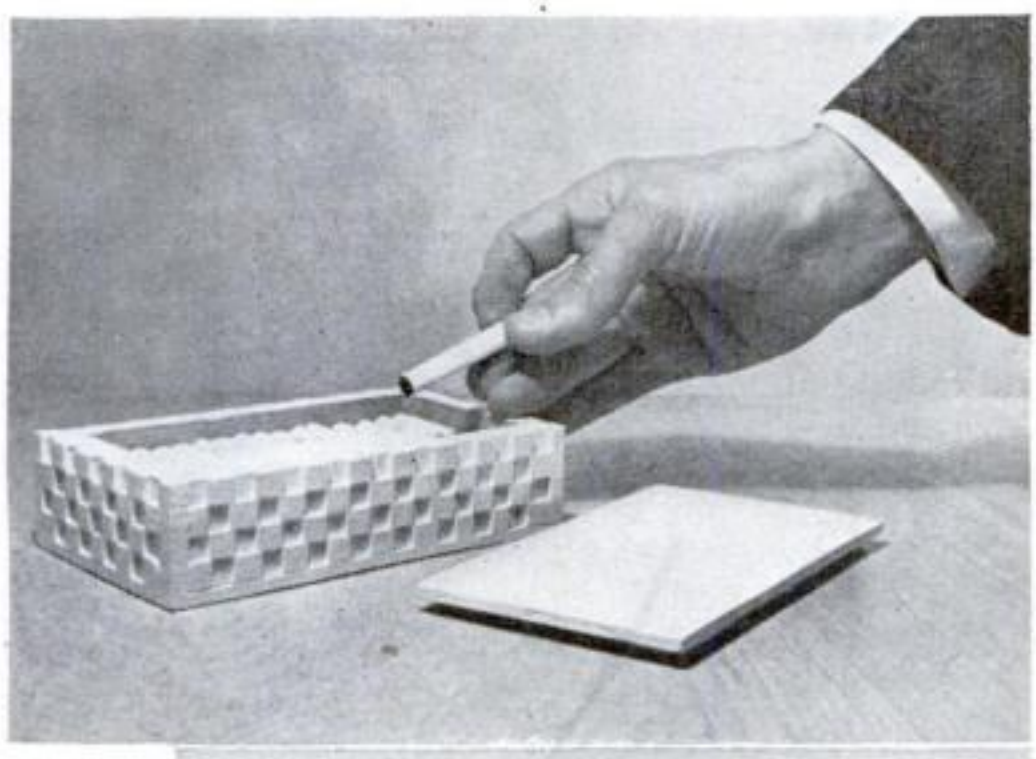
A ⅜" hole bored through the exact center of each square will provide space for wiring and permit tight fitting of an inch or two of standard threaded tube at the top to take the lamp socket. The lower square should be bored from one side for the cord.

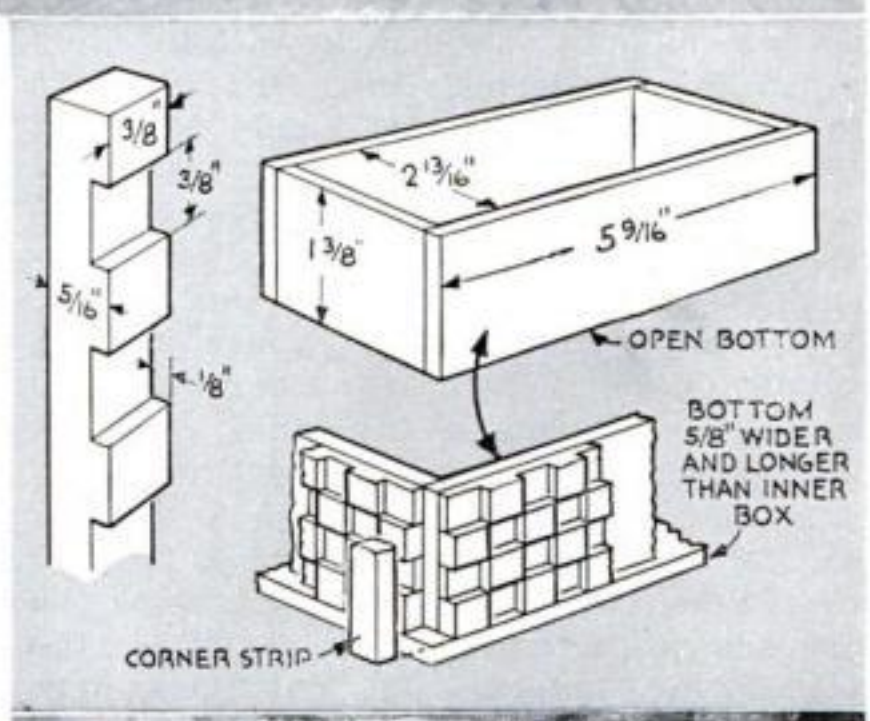
Assemble the base by nailing and gluing alternately notched squares on top of each other, as in Fig. 3, placing squares with raised corners at the top and bottom.

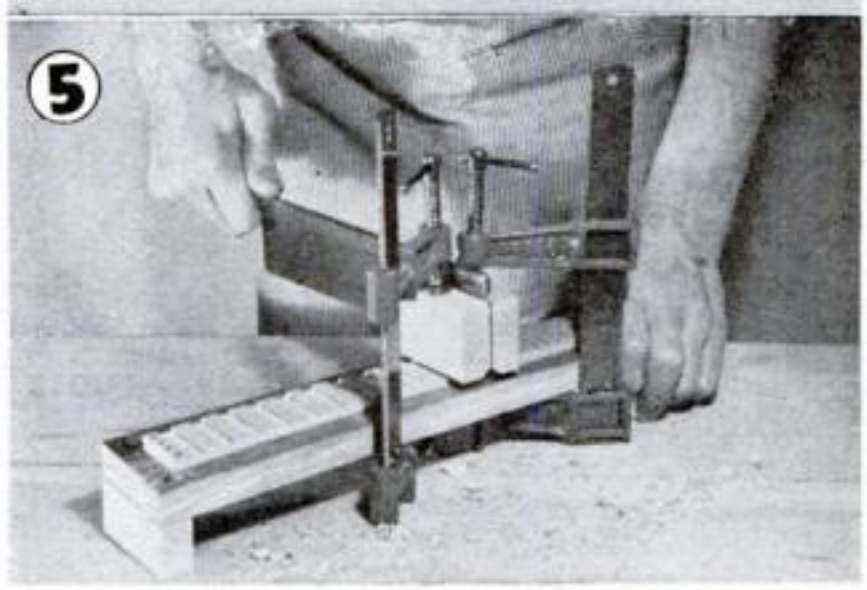
The checkerboard sides of the cigarette box are built up of notched strips glued to a simple inner box, as shown in the drawing. Dimensions of the box may be changed to suit the thickness of the stock, but it should be remembered that the 2 13/16" inside width is right for standard cigarettes.

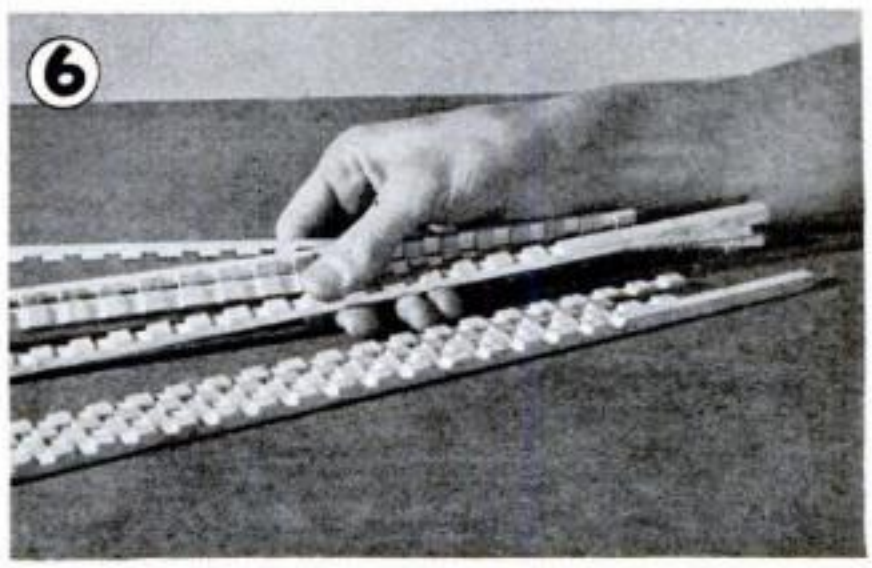
Figure 5 shows a method of notching several strips at one time. The strips are nailed at the ends to scrap wood which is raised on two blocks to permit attaching clamps to a saw guide similar to that used for the lamp. Chisel out the sawed notches, arrange the strips with notches alternating, as in Fig. 6, and saw the ends even.

When painting the lamp and box, work with as dry a brush as possible to avoid having paint collect in the depressions. A two-tone effect is best obtained by painting before assembling the pieces.









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PILGRIM TRESTLE TABLE AND BENCHES

By Norbert Engels



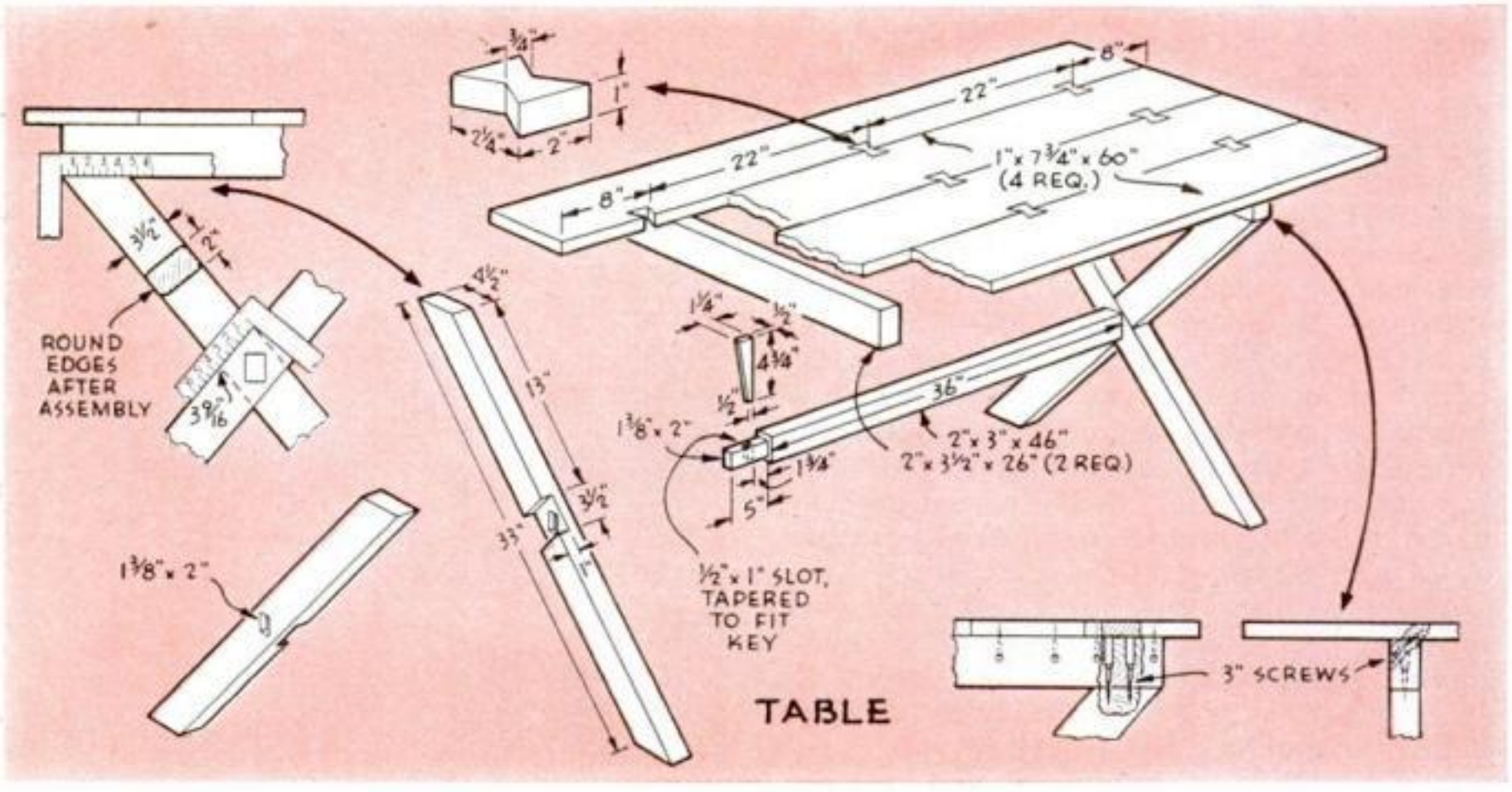
IN COLONIAL days, tables were often made with sawbuck legs that were held together by mortise-and-tenon joints. At each joint was a drawbore—a through mortise and tenon joint locked with a tapered pin. When the pin is tapped into place, it draws up the tenon and makes a tight joint.

Another distinctive feature of our forefathers' homes was the plank flooring. It was kept from spreading and warping by wooden keys that were shaped like butterflies. Such butterfly keys are, technically speaking, double dovetails.

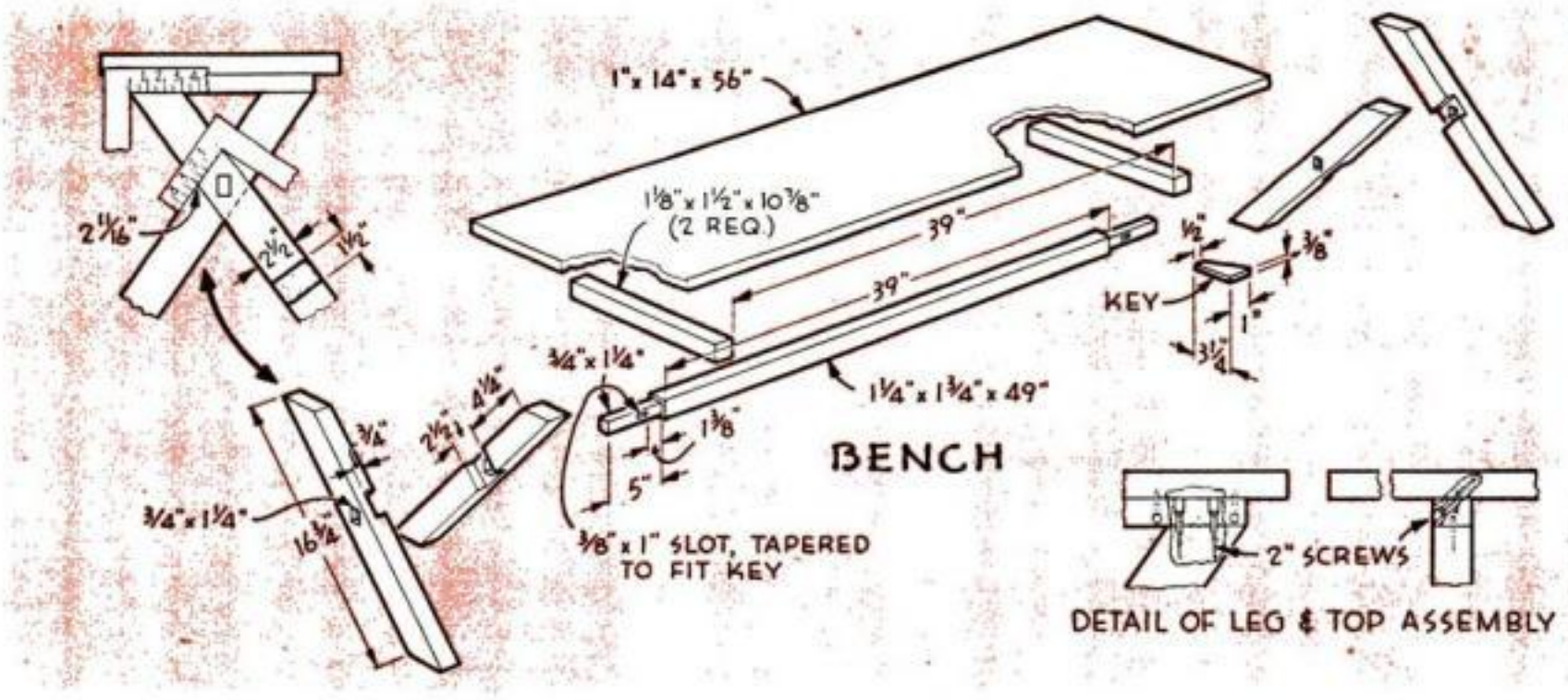
Both of these characteristics—the drawbore and the butterfly joint—have been incorporated in the design of this table-and-bench set. It accommodates six people comfortably. If more places are desired, a chair of complementary design may be placed at each end of the table.

For indoor use, make the table top of maple, birch, or white pine. For outdoor use, make the top of rough-sawn or finished oak planks. Plane the inside edges of the boards straight and square, mark off the butterfly-key notches, and cut these with saw and chisel. Use straight-grained maple or birch for the butterflies. Clamp the table-top boards together and place the dovetail material cross-grained under one of the key slots. With a scriber, ice pick, or hard pencil, outline the slot on the stock; then cut out the key. Draw, cut, and fit each key separately. To finish the top, apply thin glue to all edges, fit each key into the proper slot, and clamp the assembly together until thoroughly dry. If you wish, you may add dowel pins or splines, but they are not necessary.

The trestle frame is hard pine; don't substitute lighter material—there is considerable strain exerted at the drawbore and lap joints. Use a steel square as indicated to set the legs to the correct angle. Make the drawbore pins of hardwood, rounding each slightly along the tapered edge. The mortise into which each pin is driven is cut so the back surface is ¼" deeper than the outside surface of the leg. This recess per-



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mits a tight engagement of the pin against the leg. Also it allows for further adjustments should time and use combine to work the pin lose. Without this extra recess it is almost impossible to get a joint that will stay tight. To assemble the table, turn the top upside down, set the frame in position, and fasten with 3" wood screws.

When you have finished the table, construct two benches to match, following the same sequence used in assembling the table. Each bench top is made from a single plank or two glued pieces without butterfly keys.

Thoroughly sand and clean all three pieces. Apply any finish that will stand daily wear and that is in keeping with the solid construction. The illustrated set has three coats of the best waterproof varnish rubbed down dull. Paste wax is applied



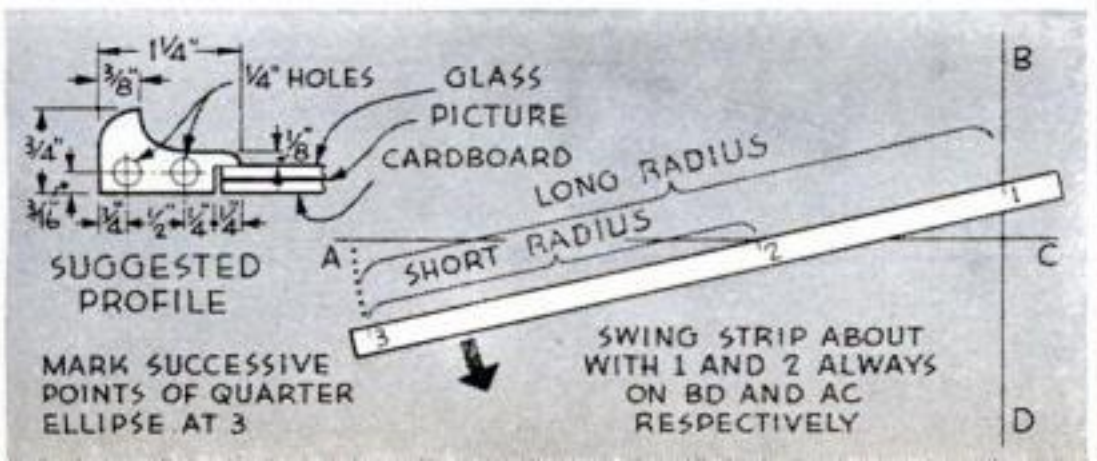
once a week. It has been in constant use for ten years and shows not the slightest sign of wear except for the inevitable shoe scars on the stretchers.

How to Make an Old-Fashioned Elliptical Picture Frame

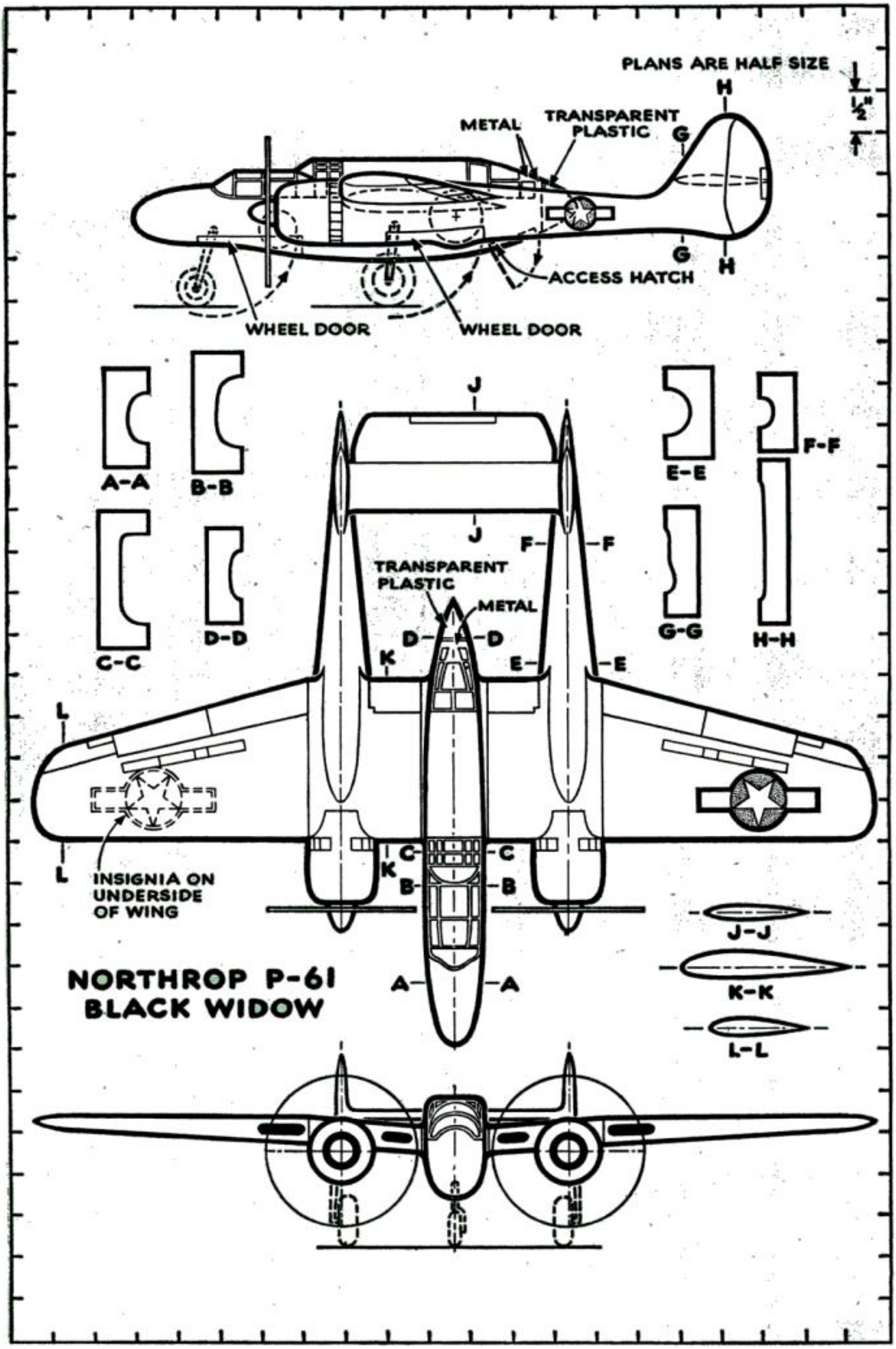
AN ELLIPTICAL frame is well suited to some pictures. It also makes a charming background for a mirror. Lay off the long radius of the ellipse on a strip of paper and label the end points 1 and 3. From point 3 measure back along the strip the length of the short radius and label the new point 2. On a piece of pattern paper, lay out line *AC* and perpendicular *BD*. Put the strip on the pattern with point 2 touching *AC* and point 1 touching *BD*. Mark a dot at point 3. Revolve the strip a short distance, keeping points 1 and 2 on their respective lines, and make a second dot at 3. Continue in this way until a series of dots has been made along a quarter of the ellipse. Draw an even curve through the dots, and a second line parallel to the first to represent the outside of the frame. Transfer this pattern on the frame stock. Saw out the quadrants and join them with dowels and glue. Dowel holes may be bored in the drill press with the aid of a jig as shown at left. Bind the frame with a tourniquet clamp until the glue is dry; then run in the molding on a spindle shaper.

If you prefer, you can simply round the frame by hand with a rasp and sand it smooth.—E.M.L.









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MODELING THE BLACK WIDOW

Miniature of the AAF's New P-61 Night Interceptor-Fighter



Built by Northrop and flown by the AAF, the Black Widow is one of our latest and most deadly weapons

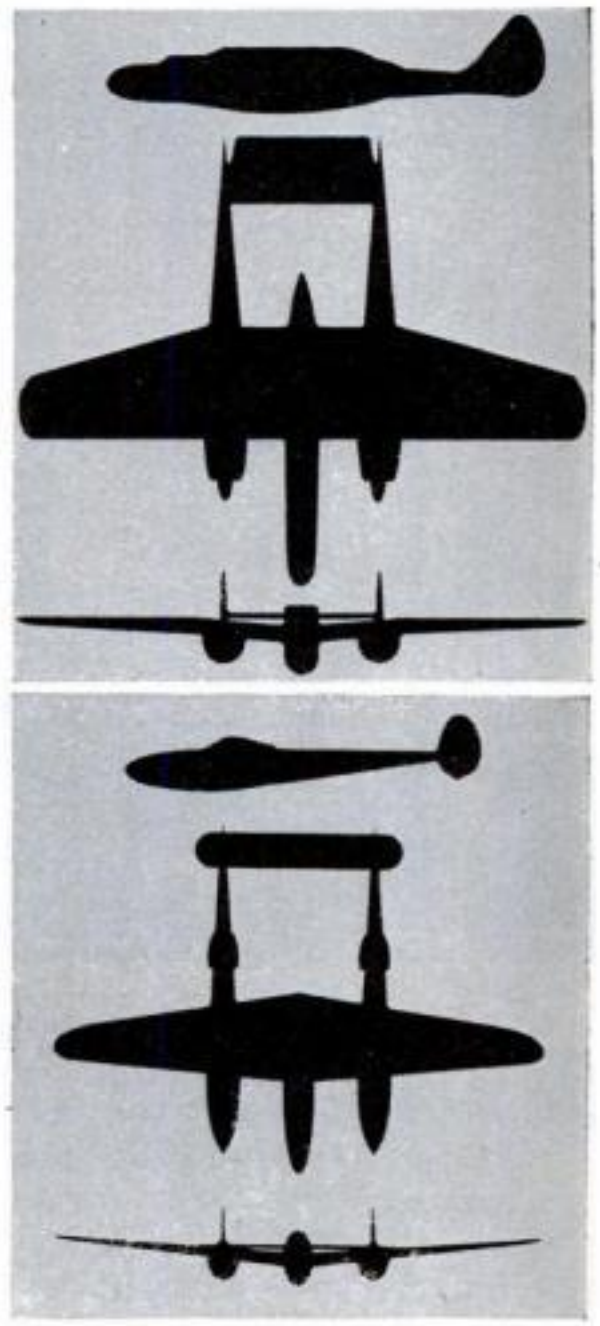
NOW being loosed to haunt the Axis like a ghost of the midnight sky, the AAF's new interceptor-fighter—the P-61—is ebony in color for low visibility at night, as deadly as human ingenuity can make it, and so maneuverable and powerful that special tactics had to be invented by the Army for its use. It is appropriately named Black Widow after the voracious spider. Capable of extremely high speed at medium altitudes, it is our first twin-boom radial-engine fighter. The long gondola holds a three-man crew—a pilot, a gunner, and a radioman.

Because of its distinctive characteristics, it is easily recognized. Head on, it looks like a Mitchell B-25 bomber. In general, it resembles the Lockheed P-38 Lightning, but it may be distinguished from that plane because the gondola extends beyond the trailing edge of the wing and the elevator does not extend beyond the rudders. Also, it has radial engines as opposed to the in-lines of the P-38.

The construction of the model is similar to that of the other models in this series (see, for example, P.S.M., Nov. '44, p. 165). Note that heavy lines enclose the model in the accompanying drawing. When taking off dimensions, measure to the inside of all such lines. The wing is best made all in one piece, then cut into four sections and fastened to the gondola and the booms with dowels, glue, and wood putty. Finish the model with dull black paint.

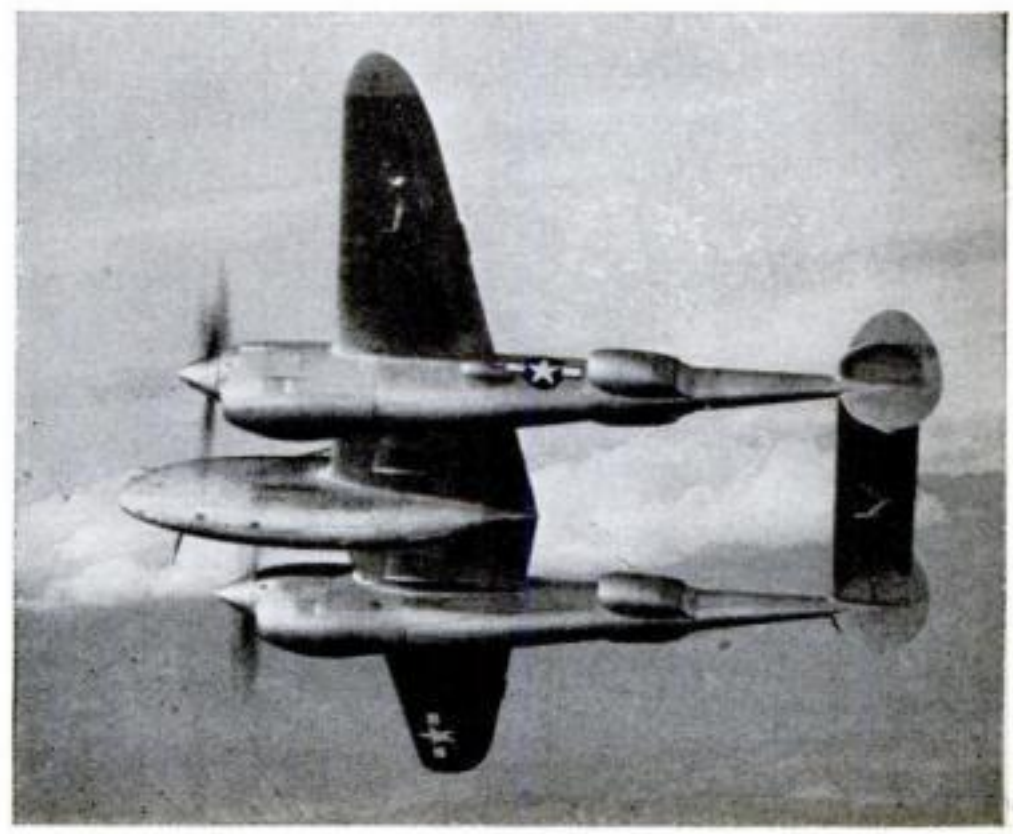


Above, a crew member uses the rear access hatch as a means of leaving the plane. Above him looms the transparent plastic tail of the gondola



At the right appear two three-view plans that demonstrate the differences between the P-61 Black Widow, upper silhouette, and its cousin, the P-38 Lightning. The side view shows that the P-61 is bulkier and has a large, rounded tail that is unlike the P-38's egg-shaped rudder assembly. In plan, the Black Widow gondola extends aft of the wing and the stabilizer does not show outboard of the rudders. Head on, the Black Widow somewhat resembles a B-25 medium bomber

Compare the Lockheed P-38, below, with the P-61 above





MADE IN HOME WORKSHOPS

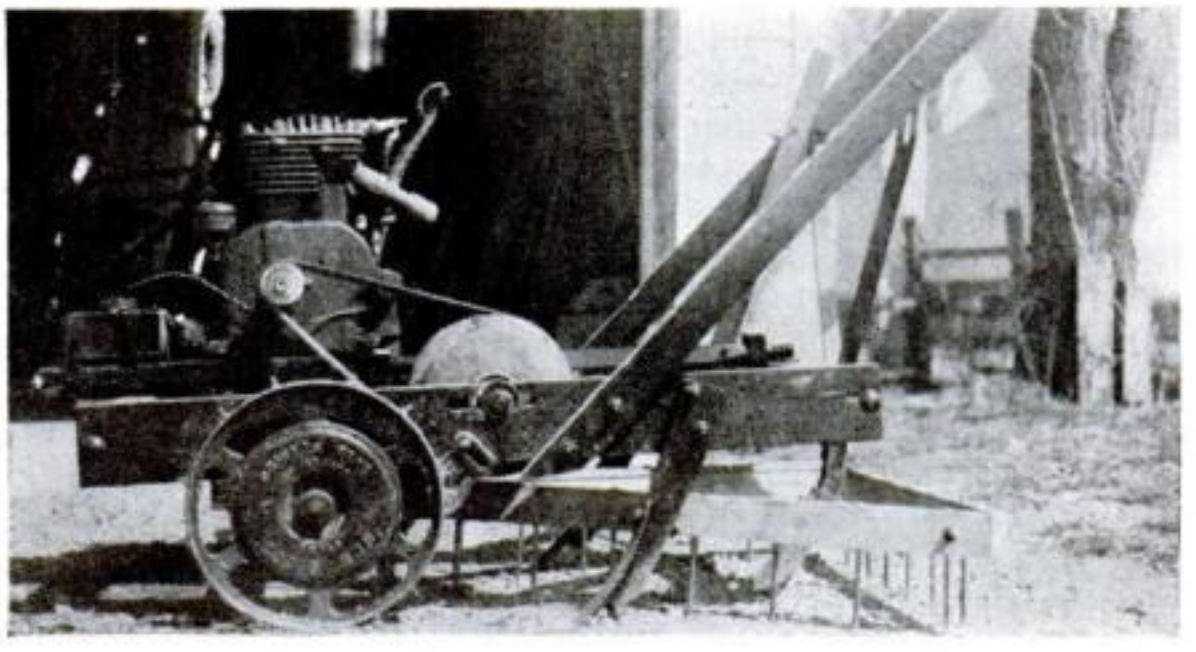


CARVING is both an occupation and a pleasure for Michael Gressel, of White Plains, N. Y., who spends weeks on a project. The heads shown above are full size in wood; the figures at right are 30″ in limestone.

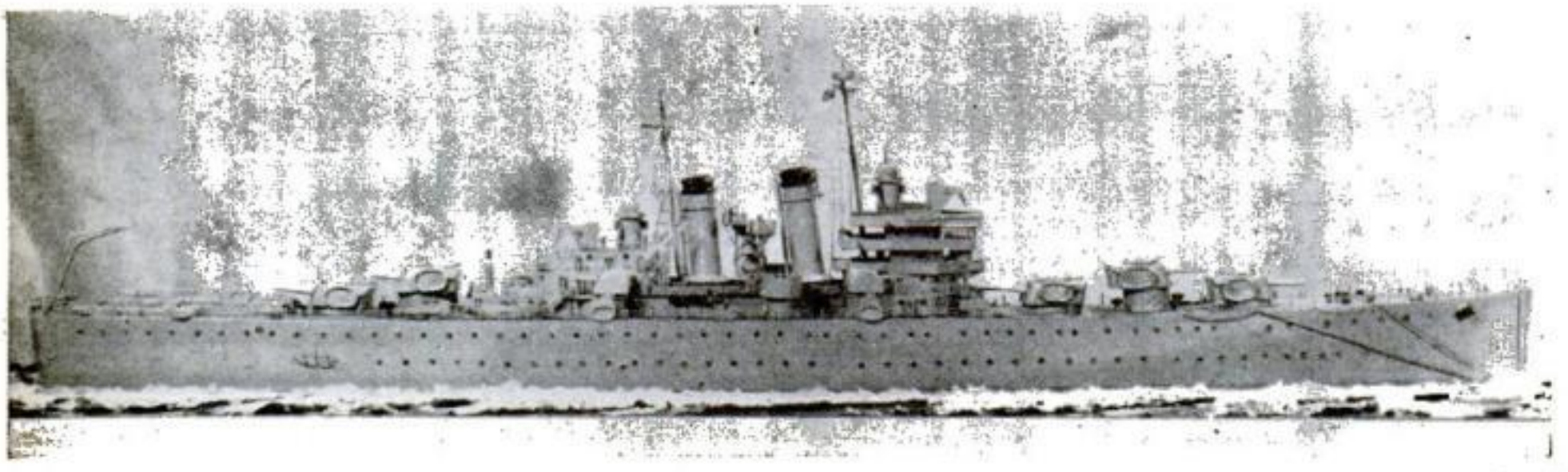


A FERRIS WHEEL made by D. D. Dalrymple, of North Warren, Penn., utilizes a washing-machine wringer post and a vacuum-cleaner motor. Arm lengths vary in proportion to the children's weight.

MOTORIZED GARDEN CULTIVATION is done by W. J. Musch, of Hartford, Kans., with the hand-guided implement shown below. It is built from a lawn mower, uses shovels or a harrow, and is driven by a washing-machine engine.

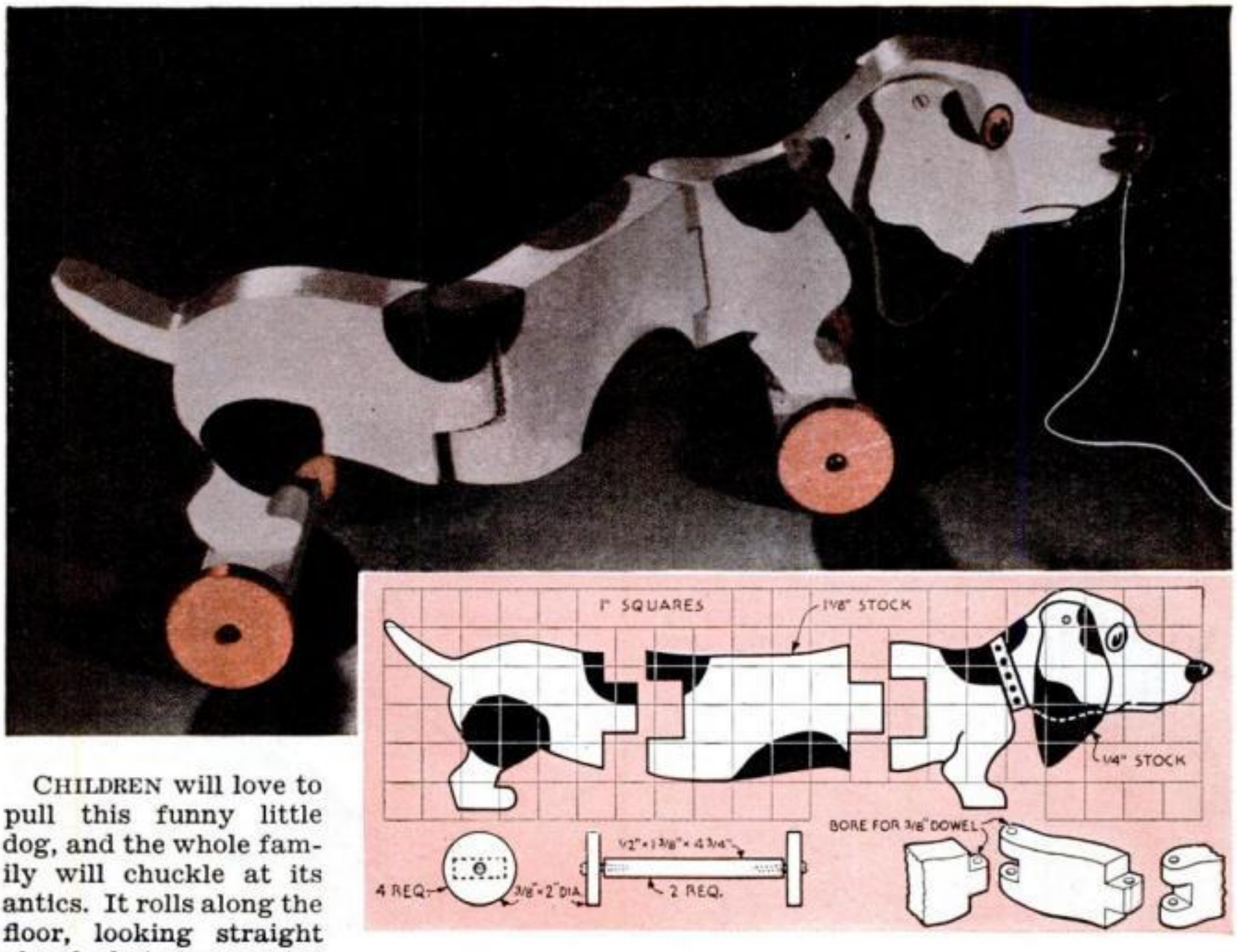


SHIP MODELS, always of interest, are especially so when they are of famous ships. This one of the U. S. S. Helena was made by Hugh Campbell, of Brooklyn, in four months of spare time from his war work as a pattern-maker at a paper machine plant.



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Comical Dog Built with Joints Wags Everything But Its Tail



CHILDREN will love to pull this funny little dog, and the whole family will chuckle at its antics. It rolls along the floor, looking straight ahead, but the center of its jointed body swings to the right and left, snapping the rear section with it in a really comical motion.

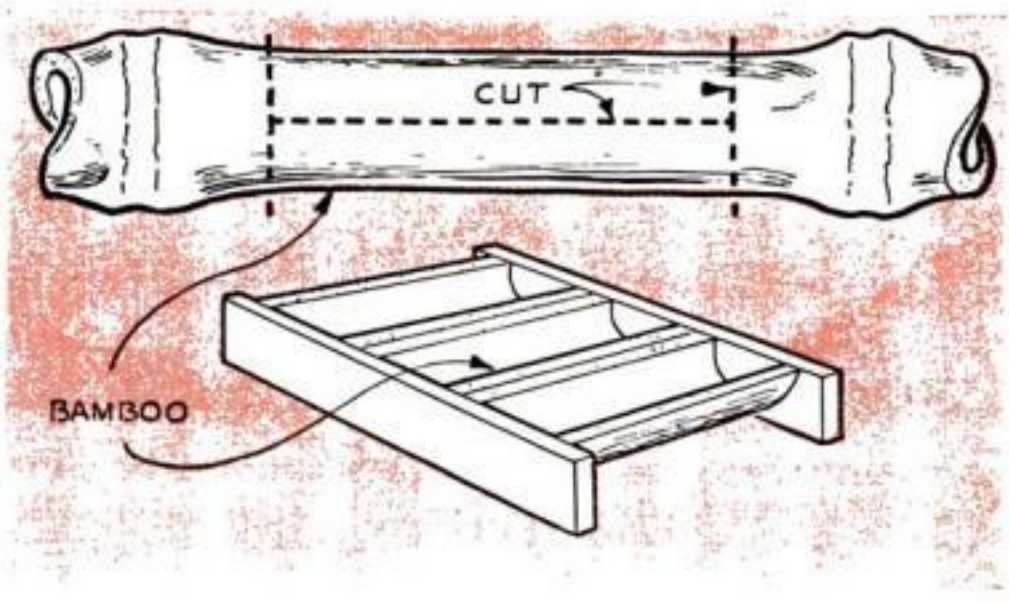
Lay out the three sections of the body on squares, as shown in the drawing, using 1⅛" stock. The ears are made as separate pieces from ¼" wood and attached to the head with wood screws. If these screws are not driven in too far, the ears will swing as the dog is pulled along.

The sections of the body are linked with ⅜" dowels or big nails, which should be a tight fit in one section and a loose one in the other. Fit the pins before rounding the joints; then shape the ends of the meeting members to allow about 30 deg. of travel to either side. More than this may cause the dog to tip over when all the wheels are on one side of the center section.

Mount the dog on two flat axles, shape wheels from ⅜" stock, drill, and attach them with wood screws.

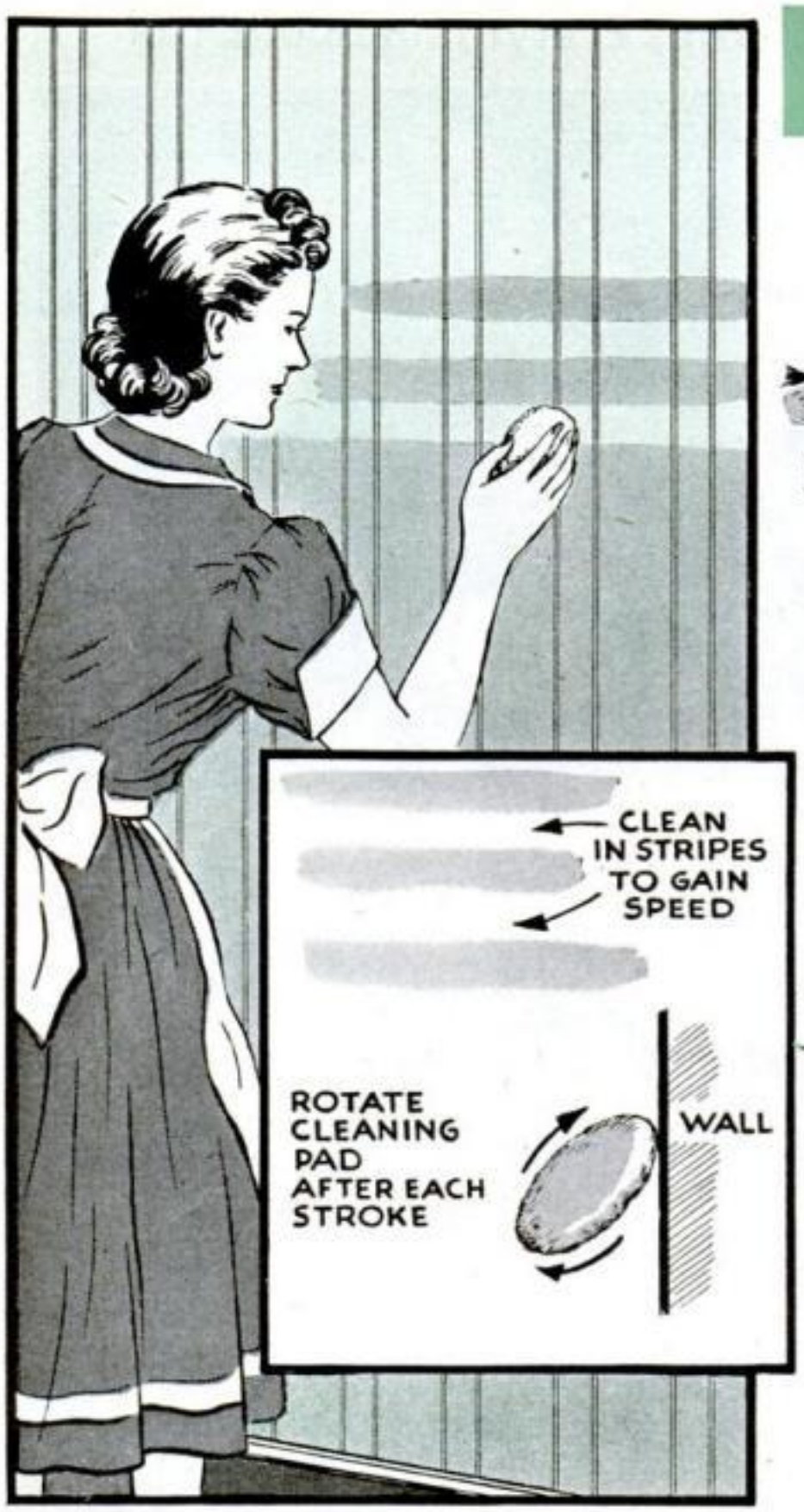
Convenient Pin Tray Made from Split Sections of Bamboo

Slit lengthwise into halves, a short piece of bamboo can be made into a useful pin tray suitable for the sewing room, a dresser drawer, or the top of a bureau. Choose bamboo of a diameter large enough for the concave sections to hold the pins; then cut it across and lengthwise, as indicated in the drawing. Three or more of these split halves are glued under pressure to endpieces of scrap wood. The joints may be strengthened with brads. Finish with enamel or lacquer in a bright color.



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KEEPING

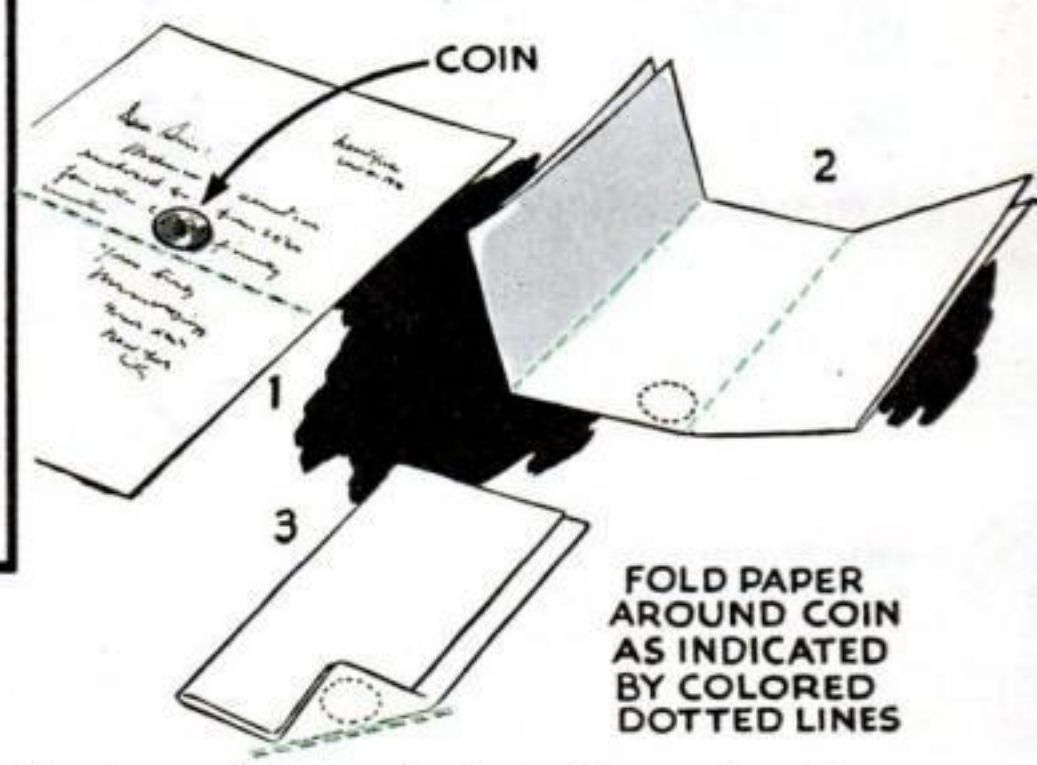


Wallpaper cleaner molded into a patty and wiped over the wall in stripes will clean maximum area at each stroke. Soiled stripes are then cleaned. Rotating a patty between strokes provides several fresh surfaces before kneading is again required



STRIP CUT FROM SLIPPER AND GLUED TO WOODEN HANDLE

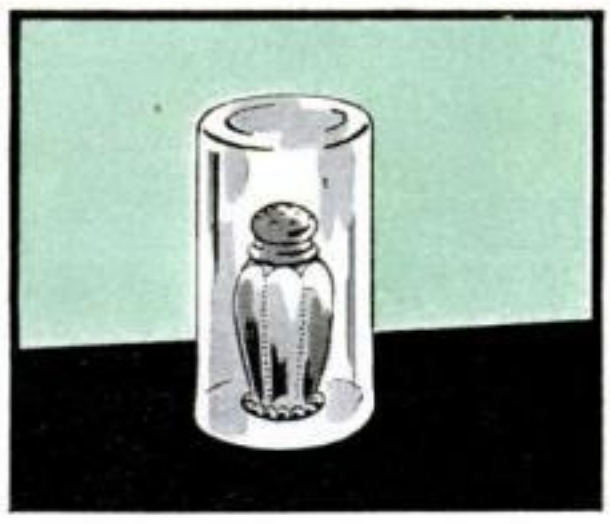
Material cut from a soft-top bedroom slipper that has worn beyond further use will make an excellent shoebrush. Cut a strip of convenient size from the top and glue it to a wood block. Make one brush for black shoes and one for tan



If coins are being enclosed in a letter, place them near the center fold, as shown, fold up, and then fold from left to right and from right to left. Shake coins down into the right-hand corner, and fold it up so they won't slide around



Families with babies will find an earthenware crock good for storage of wet diapers until laundry time. Cut a plywood cover and add a knob

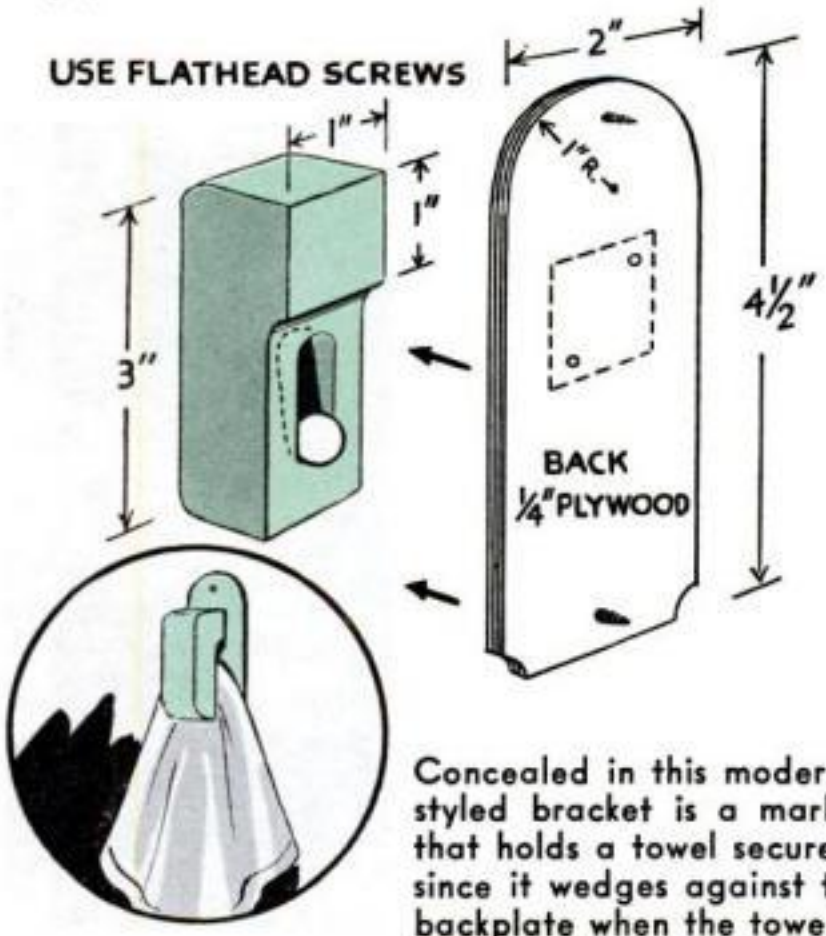


When salt is inclined to clog in wet weather, cover the shaker or cellar with a tumbler to protect it from the moisture in the air

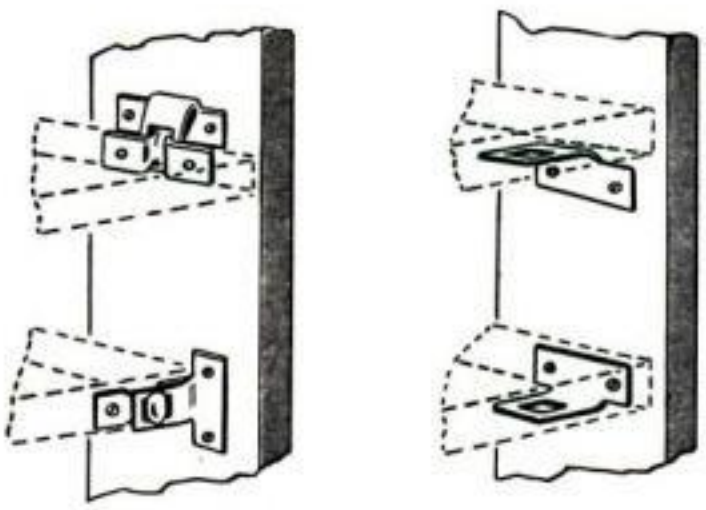


Quilting patterns won't slip on material being cut if they are made of sandpaper or cardboard covered with sandpaper

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Concealed in this modernly styled bracket is a marble that holds a towel securely, since it wedges against the backplate when the towel is pulled downward. A pull to the side and slightly upward releases the towel at once



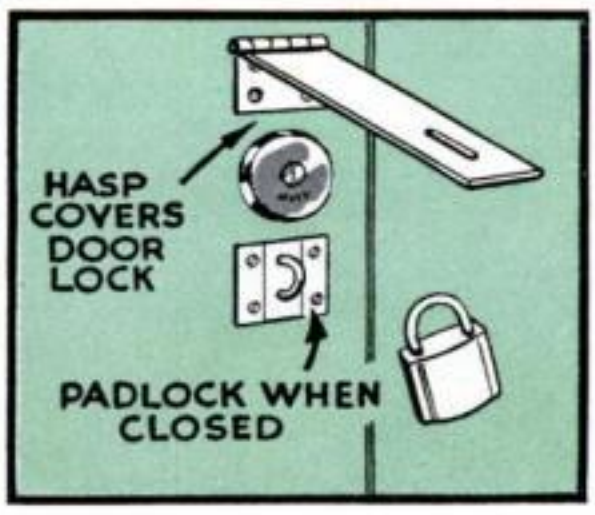
Ordinary window-screen and storm-sash hangers are useful also for installing shelves, crib springs, and other indoor fixtures that occasionally have to be removed. The hook and eye may be used, as shown at the left, or the eye may be used alone



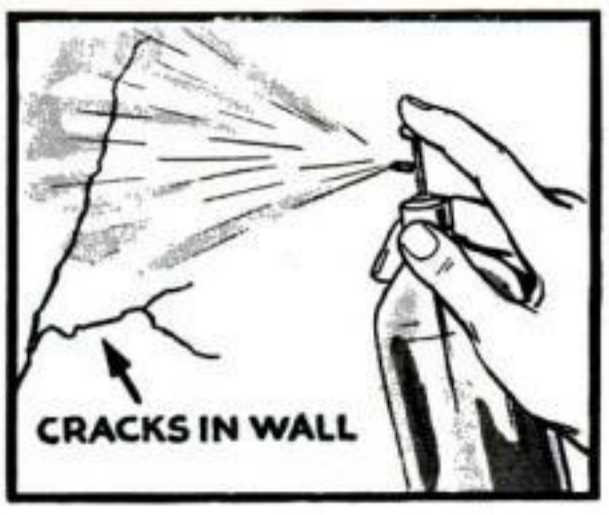
Instant lighting of a dark closet is accomplished by rigging up two cords as shown in the drawing. One cord passes through a screw eye in the frame and turns the light on when the door is opened; the other turns the light off when pulled by hand



Luminous paint on the edge of a clock glass is as effective as it is on the dial itself, and application is far less trouble



Double-locked protection may be given a door simply by adding a hasp and padlock. Put the hasp on so it covers the regular lock



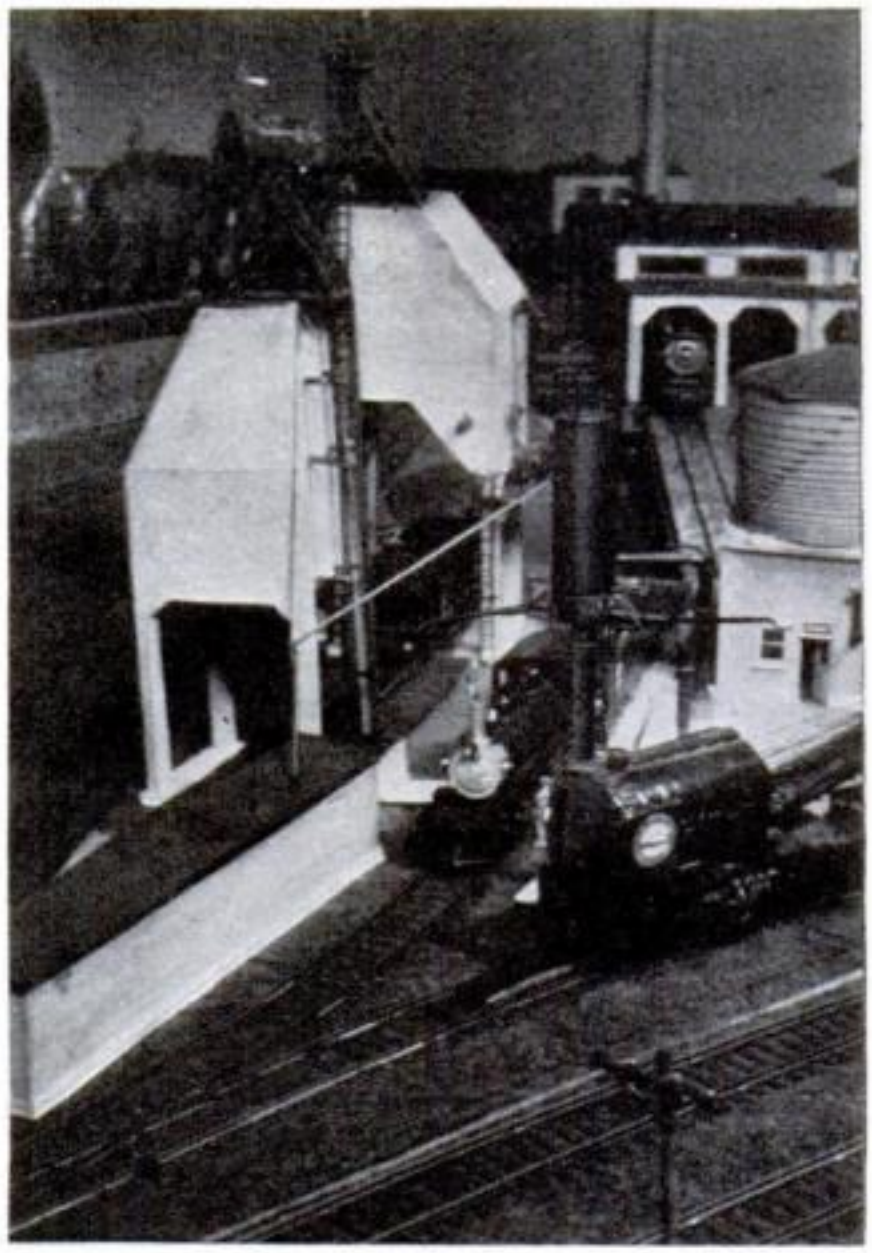
Water sprayed into a crack wets it thoroughly in preparation for applying patching cement. Use a window-cleaner spray-type bottle

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SAND TOWER

A Realistic Accessory for Your Model Railroad

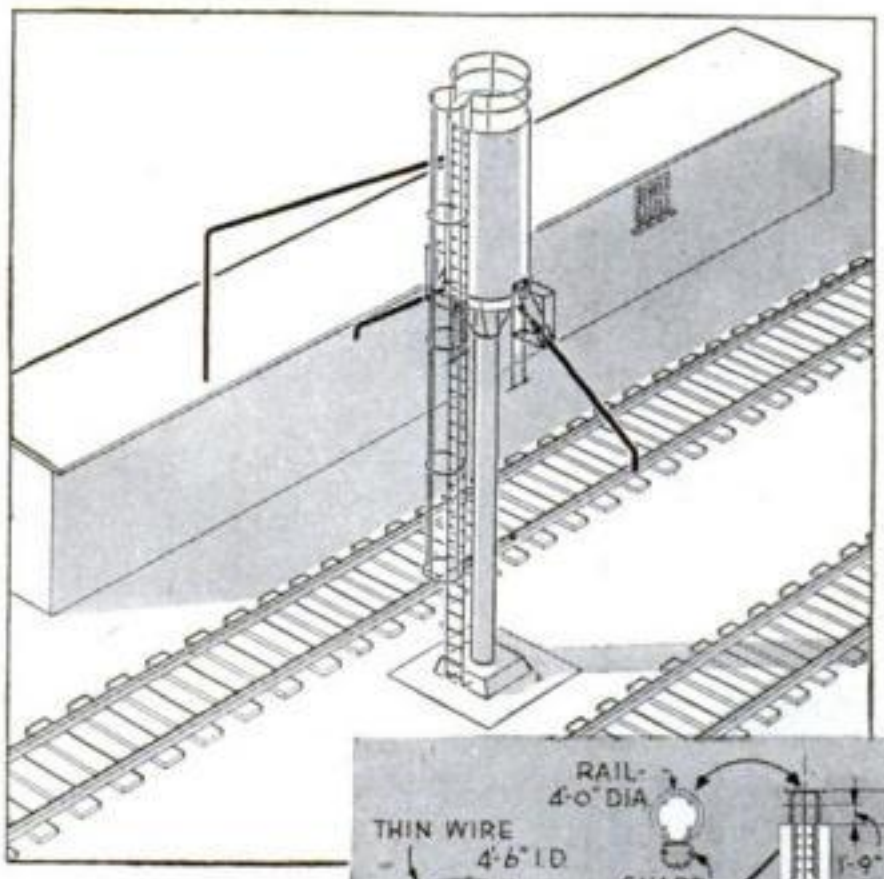
By WILLIAM SCHOPP

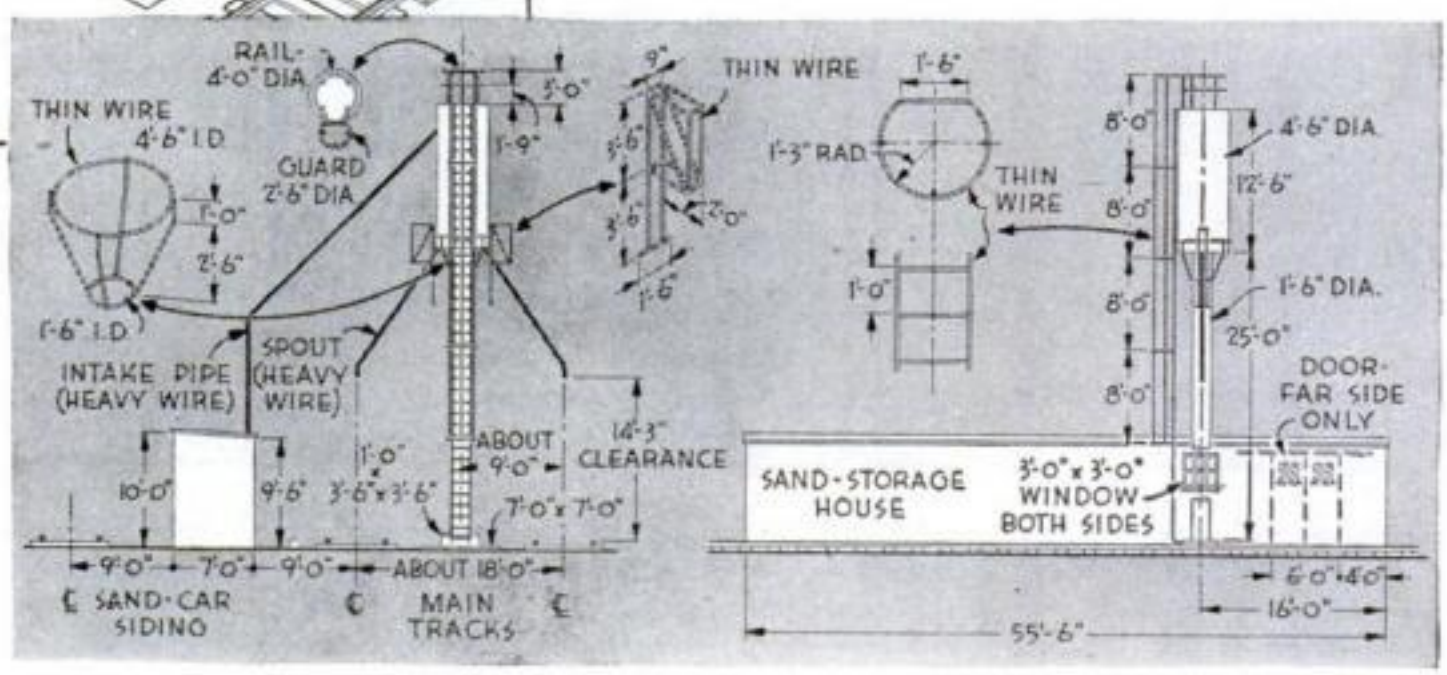


NOW that you model railroaders are right in the middle of your winter schedules, you probably are using sand liberally on the pike grades so ice won't disrupt your timetables. If so, each of you can cut down on operating costs and save many valuable man-hours by adding this sand tower to your service facilities.

Make the supporting column from a length of dowel and the tower foundation from Bristol board. Cut a hole in the foundation to take the column and glue them together. The dispensing cylinder, which in the prototype has a capacity of 10 tons, is a cardboard tube that has a disk glued in each end. It is supported by a fabricated thin-wire brace that is soldered to it and to the column. The top of the cylinder is punched to take the guard-rail vertical members. This rail and the ladder are made from thin wire that is cut and **bent to shape, then assembled with solder.** The spout hangers are also made from thin wire and are soldered to the wire brace. Use heavy wire for the sand spouts and the intake pipe. The accompanying drawings and photograph suggest that, in a two-track system, the completed tower should be placed between the main tracks.

Fabricate the sand-storage house from Bristol board, mount it at one side of the main lines, and run a sand-car siding to it. Finish the tower, the ladder, the spouts, and the roof of the storage house with black paint. To simulate concrete, use an off white for the tower foundation. Paint the intake pipe and the storage-house sides gray.





Set the tower midway between the two mainline tracks. The house is placed off to one side and is connected to the tower through a pipe that is made of heavy wire

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CAN YOU BEAT THESE PICTURES?

We will pay $5 for any photo used on this page. Write your name and address on each print. Enclose a stamped, self-addressed envelope and the negative, if it is available, and send your contribution to the Curious Photos Editor.



Some consolation to the radio ham "grounded" for the duration should be his portrait above by Harold T. Warren, of East Braintree, Mass. The sad-eyed character depicted is created entirely of radio equipment



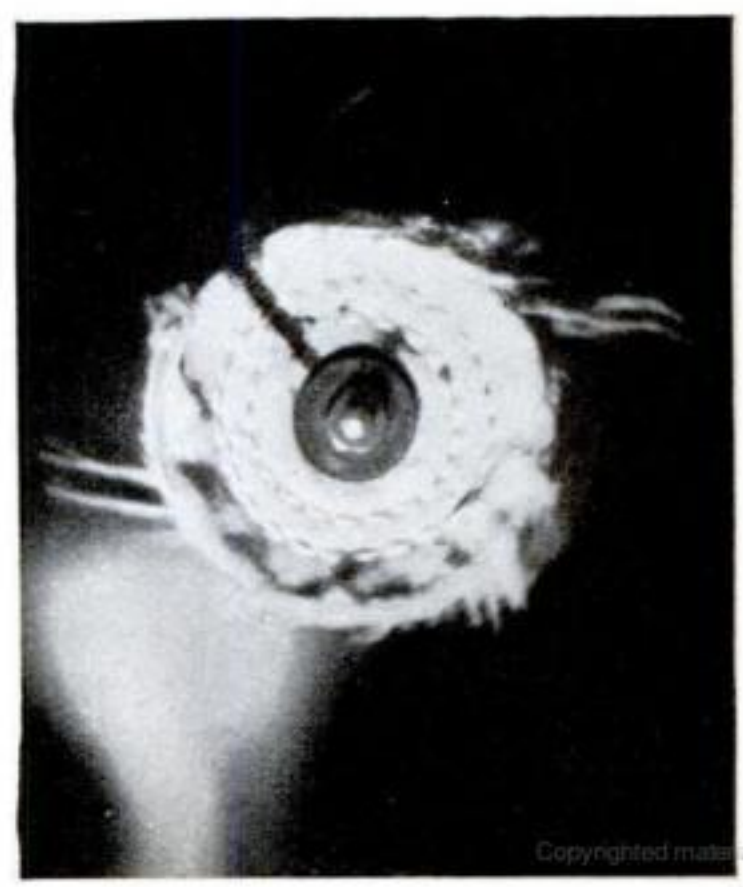
Have you ever seen a coach dog ride in style? This mascot does, answering all alarms with Engine Company No. 20 of the New York Fire Department. As a concession to motor traffic, the firemen gave him a sidecar



Judged by any standards, the photo at right is a good one. But put a partially clenched fist before one eye, squint between your fingers, and note the stereoscopic illusion. For the record, this unusual photo was taken in New York's partially finished Brooklyn - Battery Tunnel



No doubt two suns could cast two shadows, but not having them, Lt. Arthur L. Schoeni, of Arlington, Va., got this effect with one. The left image is a shadow and the other is a reflection on a wet beach



Spinning at 18,000 r.p.m., the tiny buffing wheel shown at right was stopped dead in its tracks, photographically speaking. This picture was taken by George O. Smith, of Scarsdale, N. Y., who used a homemade electronic hookup flashing a gas-discharge tube

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Universal Contrast Control with a Single Paper

By BARBARA AND WHITNEY STANDISH

REMEMBER when you could walk into your favorite camera store and buy a wide variety of photographic papers? Today, due to the war, some brands, surfaces, and colors have been completely eliminated, and others are often hard to find. This situation presents something of a problem to amateur photographers. Few of us make perfect negatives, and we accordingly need some way to compensate both for over and under-exposure. Since we now can't always do this by varying paper grades, we must have other methods whereby we can control contrast and get the best out of our negatives.

By the use of two-bath development, tone range can be varied from very soft to extreme contrast with a minimum of effort. Usually the maximum effect that can be obtained is a variation of one grade of paper either way. In other words, if you are using a No. 2 grade of paper, you can, by using a soft developer, get the same result as you would get by using a No. 1 grade, and by using a contrast developer you can get the same result as with a No. 3 grade. The greatest value of two-bath development is that any degree of contrast between these two extremes can be easily obtained.

While any combination of soft-working and contrast formulas can be used, they should be balanced so that their relative exposure speeds are approximately the same. Two formulas that work well together are Agfa 120 and Agfa 130. Both mix easily and keep well if stored in brown bottles and put in a cool, dark place.

SOFT DEVELOPER

	Stock Solution
Water (not over 125 deg. F.)	32 oz.
Metol	½ oz. + 22 grs.
Sodium Sulphite	1½ oz. + 46 grs.
Sodium Carbonate (monhydrate)	1¾ oz. + 57 grs.
Potassium Bromide	36 grs.
Water to make (cold)	64 oz.

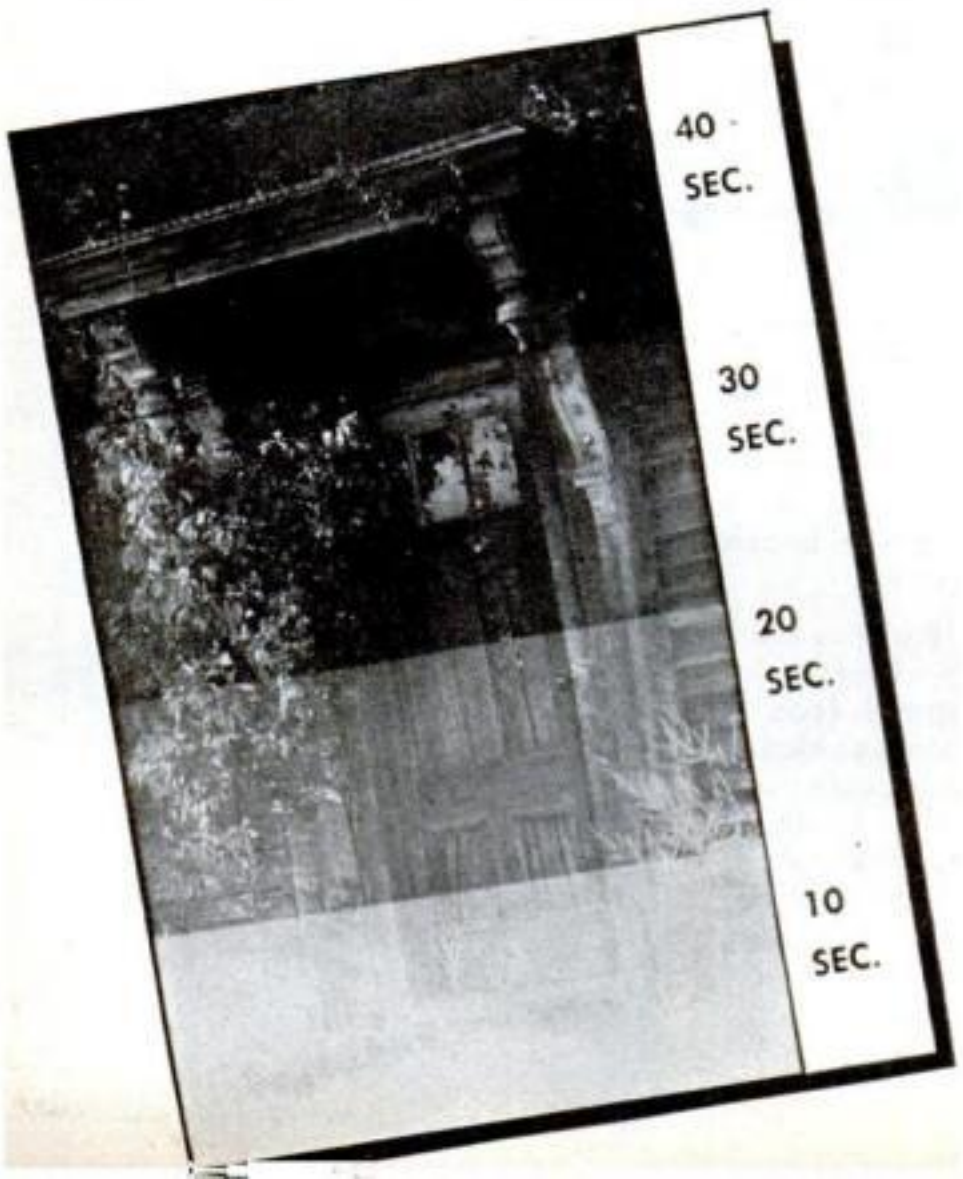
CONTRAST DEVELOPER

	Stock Solution
Water (not over 125 deg. F.)	32 oz.
Metol	64 grs.
Sodium Sulphite	3½ oz.
Sodium Carbonate (monhydrate)	5¾ oz. + 45 grs.
Hydroquinone	½ oz. + 102 grs.
Potassium Bromide	¼ oz. + 51 grs.
Glycin	½ oz. + 102 grs.
Water to make (cold)	64 oz.

Be sure to dilute the stock mixture with an equal part of water before use. When using the developers, keep their temperature between 65 and 70 deg. The trays should be arranged in the order shown on the bottom of page 171.

Now we are ready to print. First, put the negative in the enlarger and make a careful test print to get the correct exposure time for the two developers. This test print may be made by covering the printing paper with a piece of cardboard and then exposing a 1″ strip for 10 seconds. Next, move the card another inch, exposing a 2″ strip for an additional 10 seconds. Repeat until you have a series of exposures grading from the final 10 seconds to a maximum of 40 or 50 seconds.

The test print should be developed for one minute in the soft developer and one minute in the contrast developer. After it has been 30 seconds in the short-stop bath and one full minute in the hypo, turn on the light. Give the print a quick rinse in the water bath, dry it on an old blotter, and put it under a strong light so that you can correctly judge both the exposure and contrast. A test print made by this method, shown in the left column, indicates that the correct exposure for the negative is about 30 seconds. There is just one caution: be careful not to economize on the size of your test strips. Too small a strip will greatly handicap you in judging exposure.



An accurate measurement of enlarging exposure time is needed with this method. In this test strip, 30 seconds appears about right, if a trifle too dark

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The next step is to make a print, exposing it for the correct time as indicated on the test strip, and developing it the same as the test strip was developed. This will give you a chance to examine the entire print for contrast. Be sure always to judge the print under a strong light (daylight is really the best) and have it as dry as possible—a wet print always looks much more contrasty than it is. You can then decide how much more softness or contrast is necessary. The print below, which was given 50-50 development, is a bit too soft; so our next step is to use the same exposure but to develop the print for 2 minutes in the contrast developer and not at all in the soft, producing the result at the right. We have now so altered the contrast that our print is of good quality.

Our next experiment is to take a rather contrasty negative, the sort that you would ordinarily need a soft paper for to get satisfactory printing. Our first print on this (after making the usual test strip) is again developed for the 50-50 time division—one minute in each developer. This gives us an entirely too brilliant result, as can be seen from the print at the left on page 170. The sky tone is much too dark



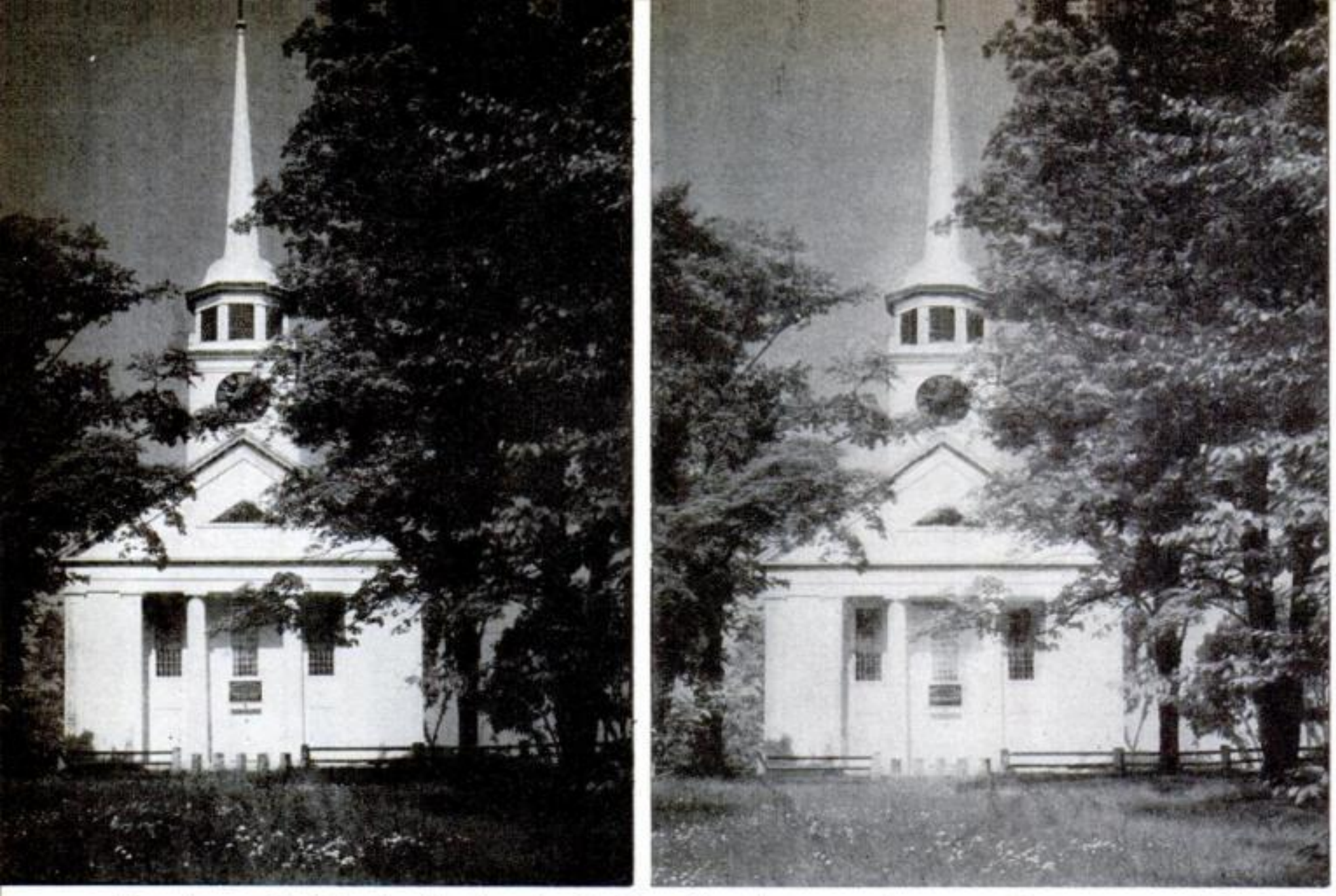


The print at the left, developed for one minute each in the soft and the contrast developers, doesn't have enough contrast. To get the good tone range shown in the picture above, contrast developer alone was used

and there is no detail in the tree shadows. However, when we make another print of the same subject and develop it for 100 percent of the time in the soft developer, we find at the right on page 170 that we have gone a bit too far in the other direction. The result is now too soft, so our next trial is the same exposure with 1½ minutes in the soft developer and ½ minute in the contrast, which results in the print on page 171. We have now corrected the sky tone and added some detail to the shadows. In varying the developing time in each of the two developers, always have the total come to two full minutes so that you can keep track of the time. Also, record the time division on a piece of paper to check your memory.

These two examples give some idea of the possibilities of the two-bath system. One advantage of this method is that when you make a number of prints from negatives of varying contrast, you do not need to keep stopping your progress to change papers. From a

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The photo at the left, taken like the others by the authors, has too much contrast if given a normal (50-50) development. If placed for full time in the soft tray, as at the right, it's better though now a bit flat

standpoint of print quality, moreover, the best prints are almost always obtained from the papers of normal contrast. Another advantage is that finer contrast variations may be obtained from this method than by relying entirely on different contrast grades of paper. Still another advantage is the money you save by using one paper; chemicals are inexpensive, while papers are comparatively costly.

Let's assume that we have some very flat and very contrasty negatives and we find that the extremes possible by two-bath development will still not give satisfactory results. However, we are not at the bottom of our bag of tricks by any means, and much can be done to increase our control still further.

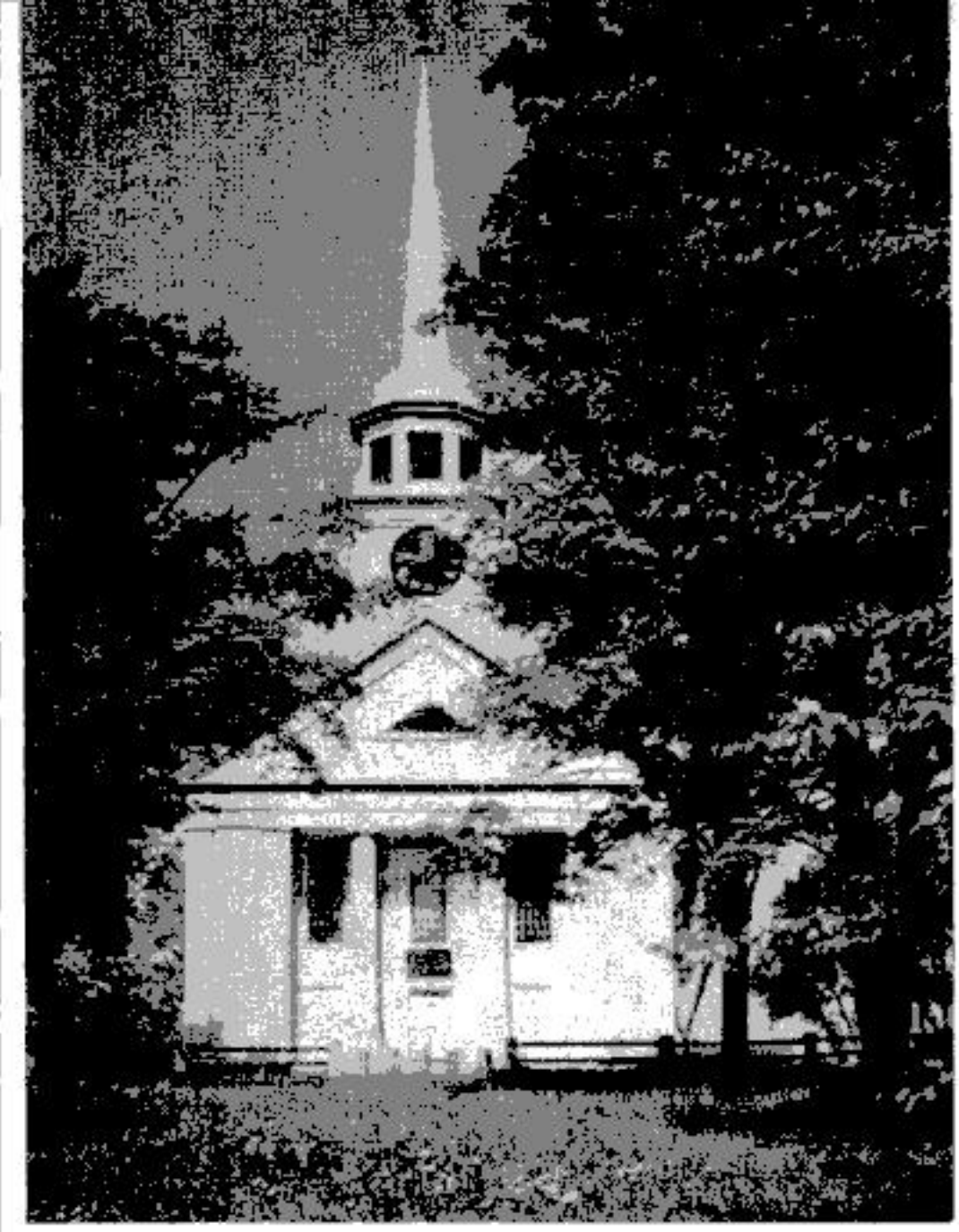
At the top left of page 172 is a print from a high-contrast negative developed 100 percent of the time in the soft developer. Despite this it is still too contrasty; the background is too dark and the sunlight too white. We now take a pan of plain, cool (65-deg. F.) water and put it beside the pan of soft developer. Make a print with about 10 percent more exposure time than the previous one, and develop it as follows: First, put it into the soft developer for 45 seconds, and then quickly take it out and put it into the plain water, moving it about a bit at first and then allowing it to rest quietly. After one minute in the water, put it back into the soft developer for 45 seconds more. Finally, put the print into the short stop and the hypo.

Thus the print, which was exposed for 10 percent more than would be normal for two-minute development, spends a total of 1½ minutes in the soft developer, separated by one minute in plain water. The photo at the top right of page 172 shows the result. The house is now lighter and we have softened the print, giving a more "atmospheric" effect.

Development with alternating water baths is a most useful device for the photographer —it saves many an otherwise unprintable negative. The soft result is obtained because the paper gets saturated with the developer during the first 45 seconds of development, after which the water washes off the surface developer but leaves part of it still working in the emulsion. The final 45 seconds in the developer gives added depth to the print, although this final step may be omitted if extreme flatness is desired.

It may be that your negative is not only too contrasty, but also contains a profusion of unwanted detail. A softening screen used over the enlarger lens will not only soften this undesirable detail, but will also lessen the contrast of the entire print. Such a screen can easily be made by taking a piece

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If developed 1½ minutes in the soft and ½ minute in the contrast tray, the photo has a good tonal range

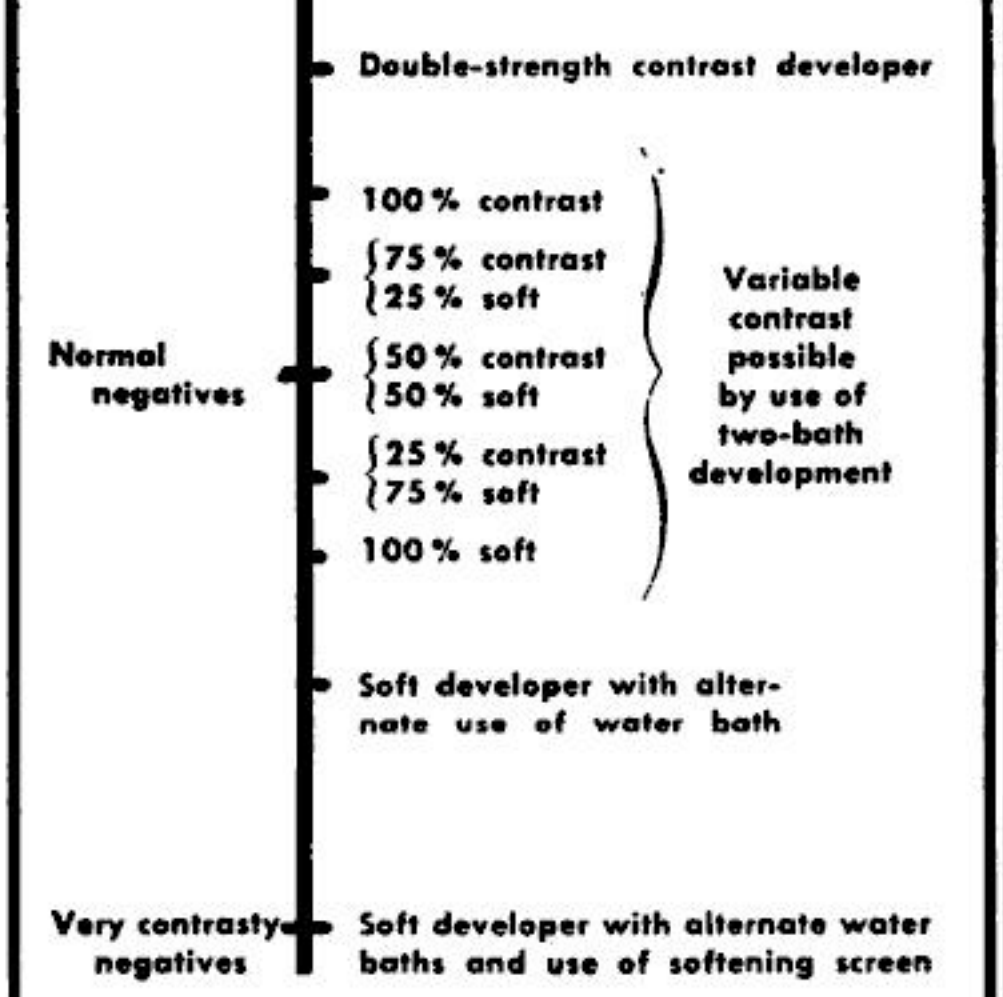
of very thin, well-washed, white silk and stretching it tightly over a small embroidery hoop. This is held in front of the enlarging lens during the exposure, and the softening result will vary according to the proportion of time the screen is used. If the screen is used for 35 percent of the exposure time, the result will be pronounced. At the bottom of page 172 is a print which was developed entirely in the soft developer but during exposure the enlarger lens was covered for 35 percent of the time with the softening screen. It is of comparable contrast with the one made by the alternate water-bath method, the main difference being a general softening of detail in the latter print.

A screen can also be made from crumpled cellophane. Take four sheets, crumple them separately in your hand, partially flatten them out, and mount them together in a small hoop. They should not be stretched. The effect will be very similar to the thin silk screen. For extreme softness, the screen can be used up to half the printing time and the alternate water-bath method can be used in developing. This will probably be too drastic for all but the most contrasty negatives.

It is much more difficult to increase contrast in your prints than it is to decrease it. However, here are a few useful tricks. Doubling the strength of the contrast developer will have considerable effect in increasing contrast. Simply use the stock solution straight without diluting it with water and you will obtain a much snappier result. Of course, you will find that exposure time must be changed and you will have to make a new test strip. With a rather soft negative this full-strength developer will often produce results of great strength and warm-toned beauty.

By increasing the amount of bromide or carbonate in the developer you will get a similar result. Mix up a 10-percent solution of potassium bromide and a 10-per cent solution of sodium carbonate and keep both solutions in tightly closed bottles on your darkroom shelf. (A 10-percent solution may

CONTRAST-RANGE CHART



NOTE: Use of softening screen will decrease contrast on any part of scale regardless of development



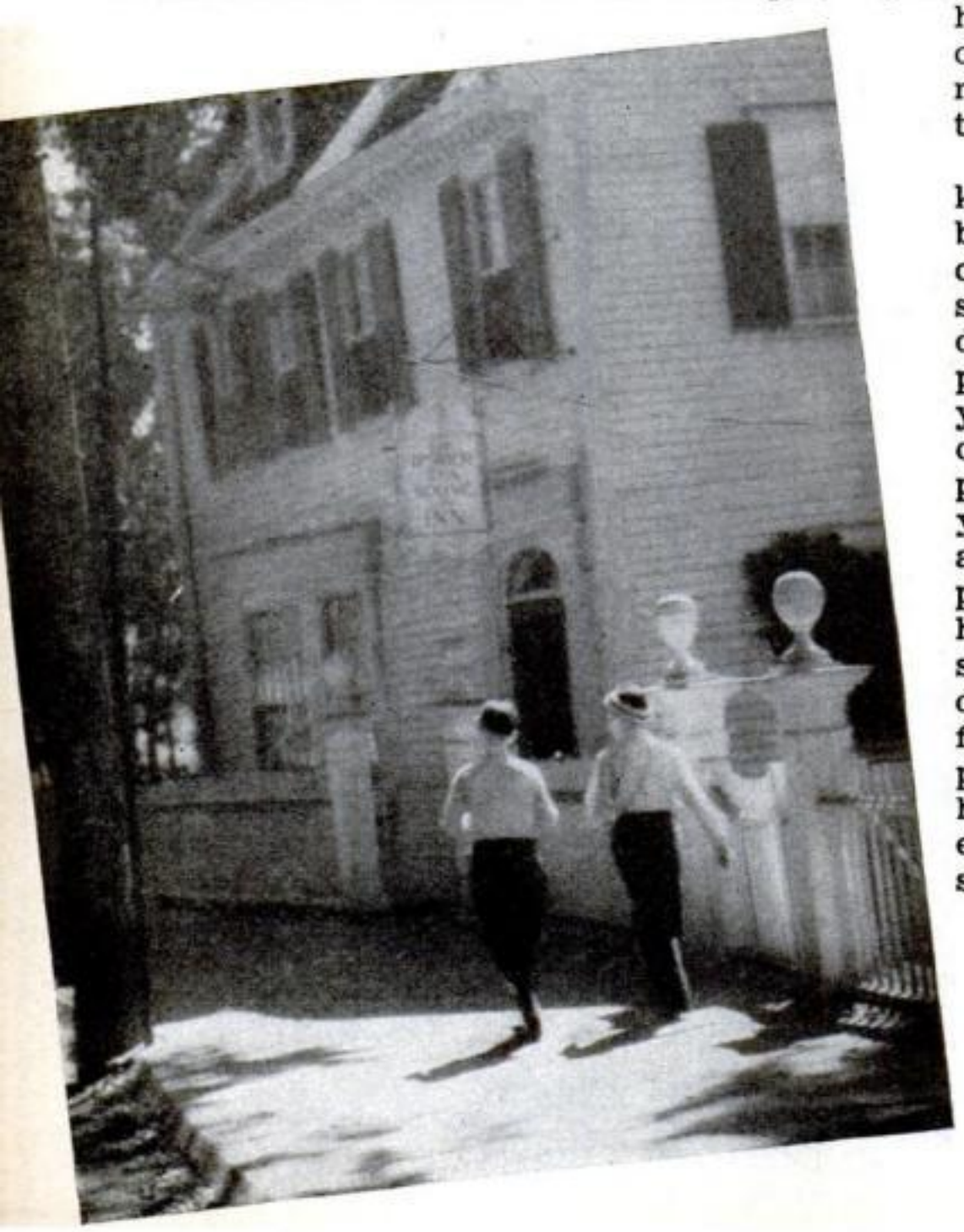
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Excessive contrast, despite full-time soft developing, marks the photo at the left. A much better quality is achieved in the one at the right by increasing the exposure slightly and using an alternate water bath

be mixed by putting 1 oz. of chemical in a graduate and adding water to make 10 oz.) If you need added contrast, even above that given by full-strength developer, add 1 oz. of the bromide solution to the developer, and if this does not do the trick, add 1 oz. of the carbonate solution. This gives a strong brew, so that if you cannot get enough contrast from the resulting mixture, you might as well discard the negative as hopeless. When you add either bromide or carbonate, you will again have to make a new test strip as the exposure time will change.

The beginner should be very sure he knows just what effect he is striving for before he makes any changes. Too often contrast values are altered without reason, simply because the photographer does not take time to look at his test picture carefully enough. If possible, you should have a really good print of correct contrast to put beside your test pictures so that you can judge just what your print needs before you attempt any modifications. Many a photographer has had the experience of working hard on a print, getting a result that satisfies him, and then finding a few days later that it is actually much too flat or too contrasty. About the only preventive measure for this—which has happened to many a salon-caliber worker—is to decide first precisely what result you want, and then to achieve it.



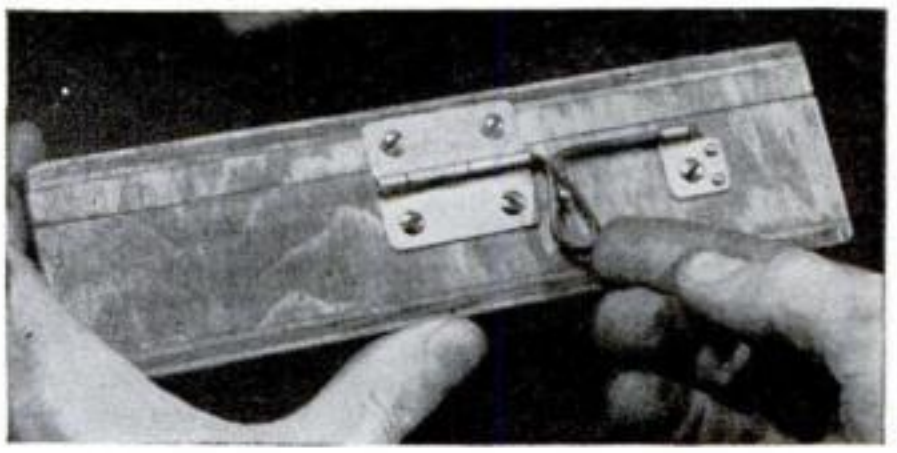
A silk screen was used for 35 percent of the exposure of the print at left. It was given soft development only. Detail is decreased; range is same as at right above

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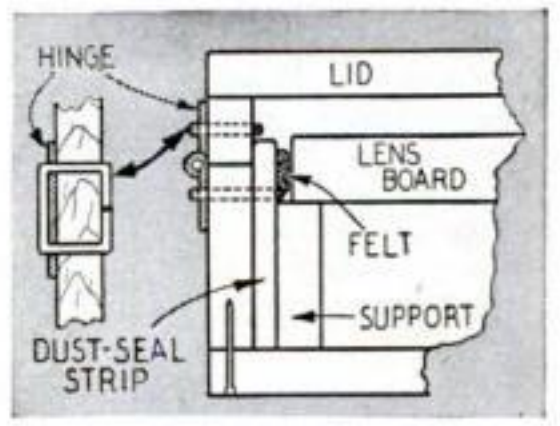


CAMERA EQUIPMENT or other precision pieces can be stored safely and conveniently when not in use in a rugged box tailored to an exact fit. That shown above was built to hold an enlarger lens. It contains two horizontal wood strips on which the lens board rests in such a position that the lens won't quite touch the bottom of the box. Felt protects the edges of the board.

Features of the construction include a novel method of attaching hinges so they can't pull loose. U-shaped pieces of hard-brass wire are used instead of screws. These are pushed through holes drilled where the hinges ordinarily go. Then the ends are bent over, hammered flat, filed down so they won't quite meet, and soldered to make a solid joint.



Used for a latch as shown above, a butt hinge and pin afford long service. Hinges at the back will not pull out if wire is used in place of screws. Solder the ends of wire together



For a long-wearing latch, locate a butt hinge on the front, remove it, drive out the pin, and then file the joints for good clearance. Bend a steel or hard-brass wire, as shown in the photo at right above, to provide a handle, and substitute it for the pin. A guide is made from a piece cut from another hinge. An escutcheon pin, driven in when the sliding pin is in the locked position, serves as a snap catch.

The usual method of constructing a box is to nail it together as a closed unit and then saw it apart, thus obtaining a perfectly matching lid. Thin strips ⅛" wider than the depth of the bottom section form a dust seal, as shown in the drawing.—W. E. B.

WINTER SCENES gliding smoothly past the camera are made professionally with the help of a sled on which cameras are mounted as shown at the right. This sled is a special one used by Twentieth Century-Fox cameramen to take actors on skis and toboggans. It has a platform that holds two movie cameras and two cameramen.

When the sled is going downhill, a skilled skier crouched over the front runners guides it over the course while the cameramen grind away to side or rear. A tractor or a winch pulls the outfit over level stretches and up hills. The course of the sled is planned in advance to minimize roughness.





EXTREMELY FAST ACTION is caught by a new film, Super Panchro-Press, Sports Type, recently brought out by the Eastman Kodak Company. It is especially suitable for work under adverse light conditions, such as indoor action and candid photos, night street scenes, and night baseball games. The steeplechase photo at left was made with it at 1/1,000 second in very poor light.

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Meet

JOHN MODROCH

The "why" as well as the "how" of repair and maintenance problems has always intrigued this long-time POPULAR SCIENCE contributor. A native of Ohio, he attended Mount Union College, and later in work with an industrial film company gained experience in the visualization of ideas. Mr. Modroch's curiosity about reasons as well as rules aided him when he was preparing this article. An oil stove of his worked perfectly except during very cold weather, when it would balk stubbornly. Routine servicing revealed no explanation. After some pondering, he probed in the tank with a stick and found the troublemaker—a chunk of ice. In bitter weather, water in the tank froze and drifted over the outlet



Forestalling Oil-Stove Troubles

By JOHN MODROCH

MANY types of oil stoves are used in homes, shops, and stores, but they all have three things in common. For proper heating the fuel-feeding system must be unobstructed, the burner must be clean and level, and the fuel must be free from water or sediment.

In any of the stoves illustrated in Fig. 1, the fuel line may be clogged by sediment, or water and air may enter and impair operation. Strainers usually keep out sediment, but they must be cleaned frequently. One or more will be found in the oil basin under a removable reservoir. They can be taken out and rinsed in clean oil while the stove is in use without disturbing the flow from the lower basin.

Strainers are placed slightly above the bottom of the pan to trap small amounts of water which, being heavier than the oil, collect and can be dumped out. The strainer in the lower basin should be removed occasionally and cleaned. To clean the lower basin itself, dip out as much oil as possible and sponge out the rest.

Fixed-reservoir stoves and those with outside tanks have a constant-level valve to establish the level at which oil enters the burner. Dirt and water can be removed by frequent draining at the sediment trap. The valve contains a cylindrical strainer, which should be rinsed regularly with clean oil after unscrewing the large plug which is located near the bottom, as shown in Fig. 2.

Air may hamper or even stop the flow of oil. Sometimes a bubble may be coaxed through a fuel line by gentle tapping. If it is obstinate, disconnect the pipe at the nearest coupling, as in Fig. 3, and reconnect the line while the oil is flowing freely.

Check the vent in the tank cover, blowing through it or using a wire to clean out dirt. Sediment in the pipe may be dislodged with a length of wire, but if the pipe appears to be very dirty, it should be uncoupled at both ends and flushed with clean oil. Bent copper tubing can be straightened temporarily to facilitate cleaning if straightening and rebending are done carefully to avoid cracking the metal or pinching the bore.

When reinstalling tubing, make sure there is no high spot where air may be trapped.

Should you find it impossible to tighten a coupling in copper tubing enough to prevent leaking, cut off the old joint with a hacksaw or tubing cutter and make a new one as shown in Fig. 4. This requires slipping on a new gasket and flaring the tubing slightly. For soft 5/16" and ⅜" tubing, a piece of tapered metal rod or hardwood dowel will serve. Keeping a couple of replacement gaskets on hand is insurance against delay when repairs are needed.

An air-bound control valve can usually be freed by opening and closing it several

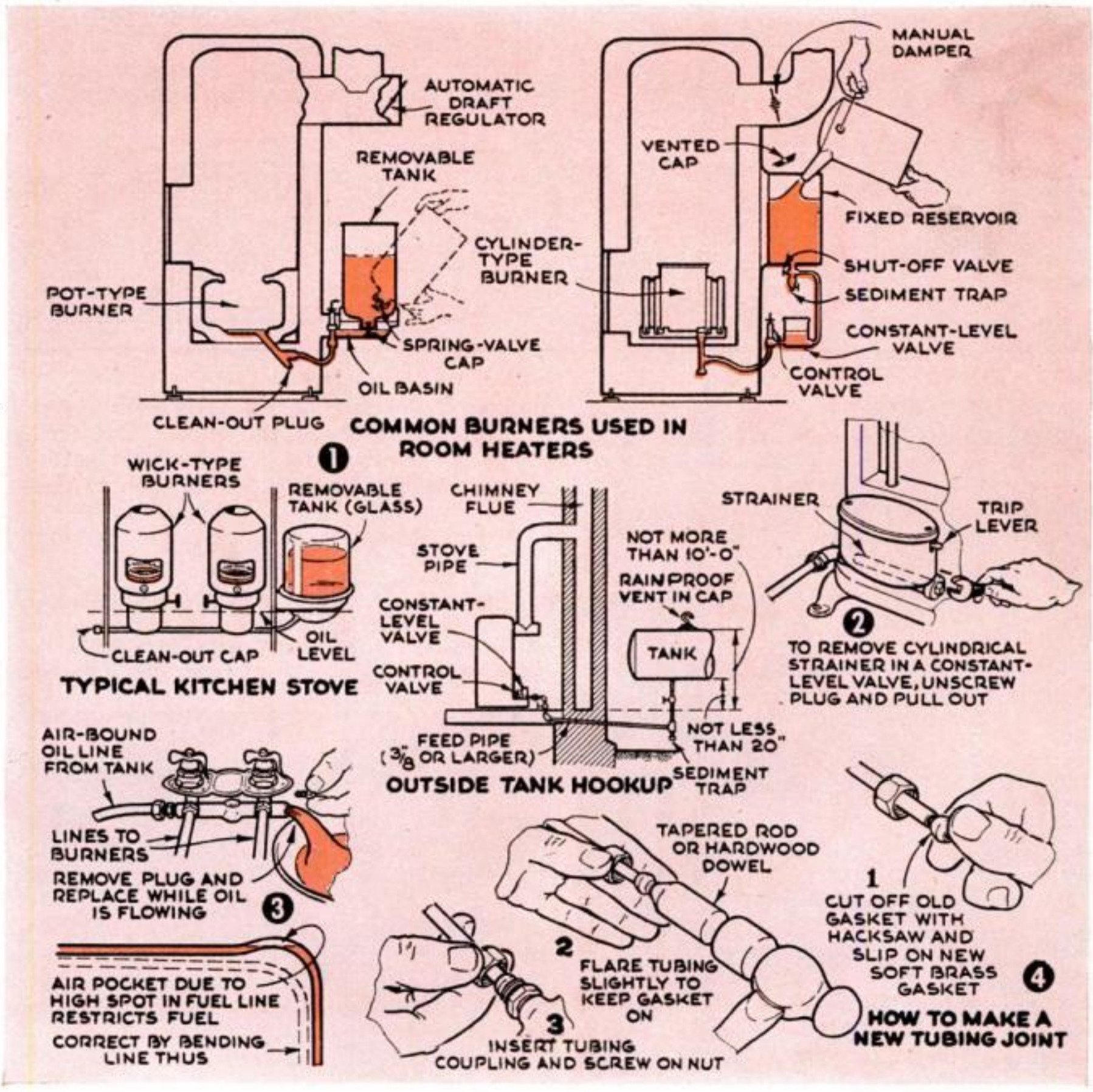
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times to let the air bubbles pass through and out of the burner. If a cleaning device is incorporated in the stem, work the stem up and down to pass the air. Water and small particles of sediment may be passed the same way. If the stoppage is obstinate, remove the valve stem to clean it, but first close the shutoff ahead of the constant-level valve, or empty the oil basin, and *let the fire go completely out.*

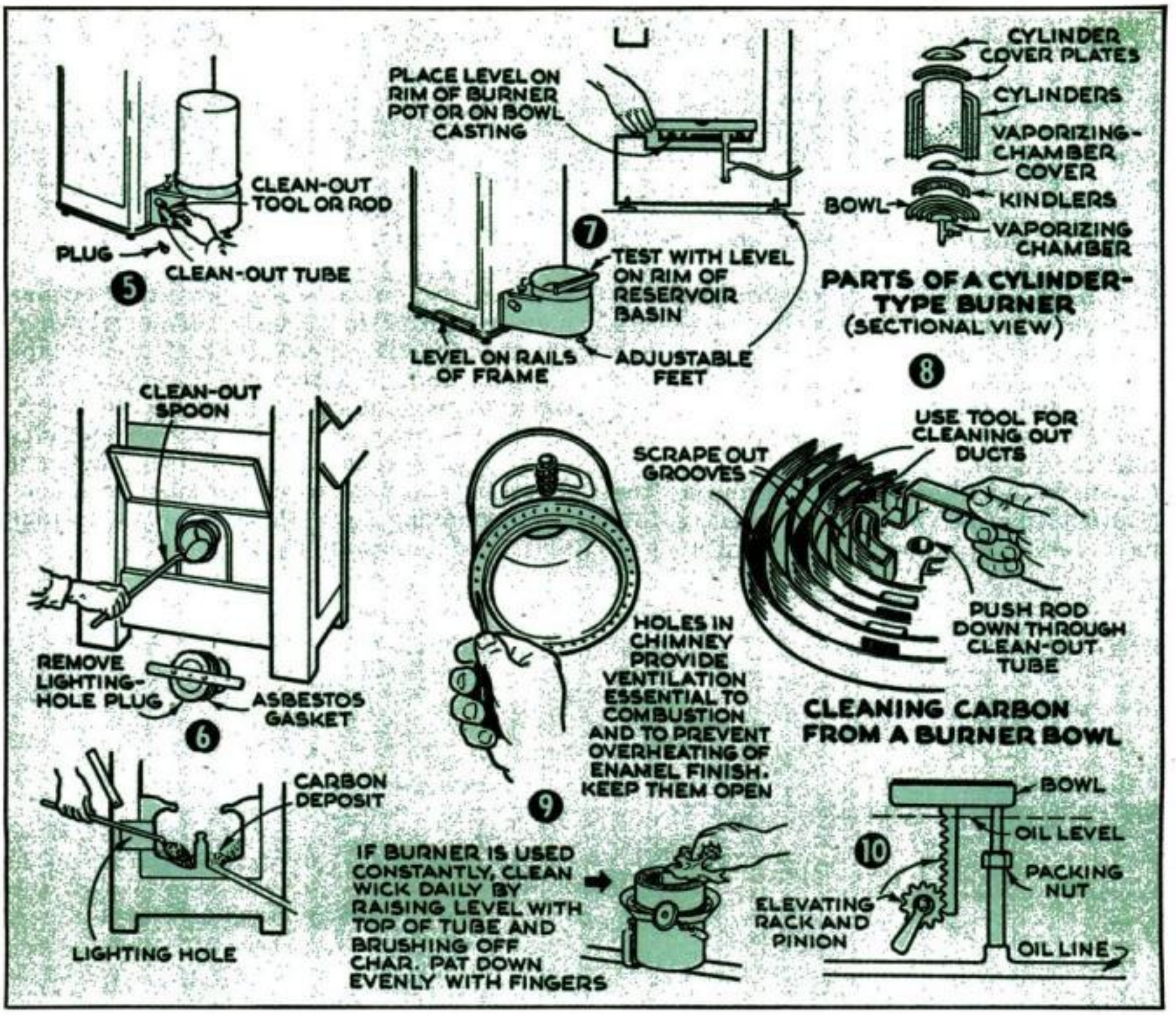
Sediment under the float-mechanism needle in a constant-level valve causes an overflow that trips the automatic safety device and stops the oil flow. Resetting the trip lever will correct a mild case, but if the trouble persists an experienced serviceman should be called.

Burners may be cleaned through the clean-out tube at the point where the fuel line enters the burner. A special tool is usually provided for breaking down the carbon deposit, or a rod may be used. Figure 5 shows such a clean-out tube projecting horizontally through the back of the stove; but it may extend down from the bottom of the burner, in which case it may be reached through the stove door or by removing the drip pan.

Carbon forms in the pot or in the bowl grooves of a burner as a normal result of combustion; but a poorly operating burner may carbon up in a matter of hours, while one that functions perfectly may need cleaning only once in a season. If carbon is allowed to accumulate beyond a certain point, it will prevent proper distribution and circulation of fuel in the pot or bowl and will also clog the feed pipe, resulting in a lopsided, smoking flame that is difficult to regulate and is low in heat content. There is



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danger of flooding such a burner and losing control of the fire if the burner is forced. One that shows signs of carbon congestion should therefore be cleaned as soon as possible.

A gloved hand reached through the front

Carbon is cleaned out of a pot-type stove through the lighting opening. The plug is unscrewed, as shown at left. Before cleaning the strainer in the basin, remove the oil with a dipper and a sponge



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door is sufficient for scooping out the carbon from the pot of some stoves. That shown in Fig. 6 has a lighting-hole plug that can be removed for use of a spoon. Be sure the asbestos gasket is on the plug when you replace it, or the opening will not be completely sealed and the stove won't fire properly. A worn or damaged gasket should be replaced with a new one, but an emergency gasket can be made by winding asbestos cord around the plug.

Carbon is cleaned from a cylinder or ring-type burner by reaching through the stove door and lifting out the parts in the order shown in Fig. 8—cylinder cover plates, outer and inner cylinders, vaporizing-chamber cover, and asbestos kindlers. If the bowl grooves are badly choked, the kindlers must be pried out, and they probably will have to be replaced. Use a cleaning tool or the blade of a screwdriver to scrape carbon from the bowl grooves, the ducts running from one groove to another, and the vaporizing chamber. Then run a rod down through the clean-out tube and push out the carbon that has accumulated inside.



After removal of the reservoir, the pan and strainers can be taken out for cleaning without stopping the burner oil supply



Broken mica windows let air in at the door where it hampers combustion. If mica can't be obtained, use asbestos sheets



Carbon choking the grooves and vaporizing chamber in the bowl of a cylinder burner keeps oil from reaching the outer grooves

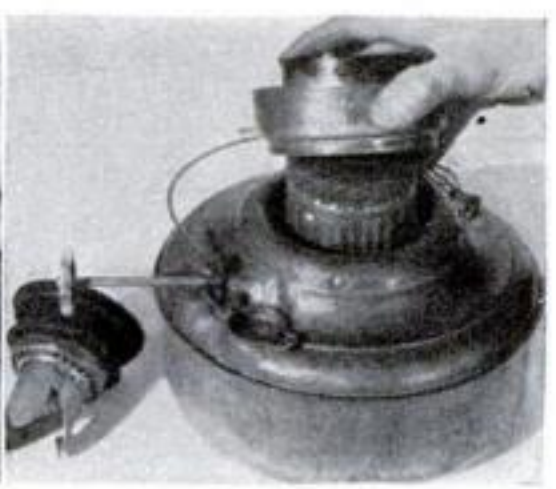


Badly charred kindlers should be replaced with new ones of the right width. They must be cut so the ends won't overlap

Wicks can be kept absorbent by frequent brushing with a cloth or paper napkin to remove char. Daily cleaning is good practice

When a wick burns too short to reach oil in the reservoir, it must be replaced. Remove the carrier along with the old wick





Hardened kindlers should be replaced. It is well to keep on hand an extra set of the correct width. The kindlers should project slightly above the top of the bowl. Cut them to length to fit the circle without overlapping.

Clean out clogged perforations in the cylinders, and replace them, making sure they are properly seated on the bowl by rotating them slightly. If the cylinders are joined with connecting rods, rotate the assembly to insure seating.

The burner should be absolutely level so the oil flow will be equal on all sides and the flame even, and the constant-level valve or reservoir basin to which the burner is connected must also be level. Use a spirit level, reaching through the front door, if possible, and laying the level on the top of the pot from side to side and from front to back. Be sure the reservoir is full, and make the adjustment by turning the screw-mounted stove feet in or out. If the burner can be reached only through the lighting-plug opening, lay the level on the rails, the rim of the reservoir, or the leveling ledges provided on some stoves. Remove the cylinder assembly and kindlers of a cylinder burner and place the level across the top of the bowl. Some stoves have built-in spirit levels.

If a stove fails to heat properly with the flame turned up as high as it will go, don't experiment with the height setting of the constant-level valve unless you are sure there is no other cause. These valves are factory set at a level that makes flooding the burner impossible, and to raise this level may make the

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stove unsafe. It is best to have a serviceman make the adjustment.

The wick of a wick-type burner conveys oil to the flame by capillary action which may be impaired by a hard crust. Frequent brushing with a soft cloth or paper napkin, as in Fig. 9, will keep the wick soft and absorbent—daily attention is recommended for a stove in constant use. Remove the flame spreader, raise the wick level to the top of the wick tube, brush off the char, and then pat the wick down evenly.

Hard carbon should be scraped from the flange of the spreader with a knife, and the perforations should be cleared with a stiff brush. Char on the wick tube can be removed with fine sandpaper. Vents in the burner chimney must also be kept open to provide proper ventilation and to prevent overheating that might crack the porcelain-enamel finish. A good scouring powder will remove boiled-over food, but never wash parts of a stove while they are hot.

A wick that has burned too short should be replaced. If the new wick cannot be fitted into the burner so its top is level all around the wick tube, it should be burned off. Drain the reservoir or shut off the fuel supply and remove the oil remaining in the feed pipe by unscrewing its clean-out plug. Then light the burner, adjust the wick to its lowest flame, and allow it to burn dry to level it. After the last spark has died out, resaturate the wick by turning on the oil supply, and then, without changing the position of the wick, remove the chimney and flame spreader and wipe the wick smooth with a cloth or paper napkin.

No smoke-pipe connection to the house chimney is necessary for a wick stove, but fresh air is necessary if the stove is to burn without smoking. This can be provided by leaving the room door or a window ajar.

For sufficient draft in a pot or cylinder burner, have the run of stove pipe as short and direct as possible, and be sure to use a size that fits the flue collar of the stove. Pot burners require a full flue opening at all times. A swinging draft regulator in the piping, as in Fig. 1, will equalize variations in chimney pull. Adjustment of the position of the weight on the regulator blade provides the degree of swinging suitable to the strength of the chimney draft.

Little draft is needed in a cylinder burner after it is once started. A manual damper in the piping will permit the draft to be cut. For both types of stove, the house chimney should be at least 20′ high; it should be free of cracks and leaks, and all unused openings should be sealed.

Figure 10 shows a burner mounted on a rack and pinion that permits raising of the burner bowl and wick above the oil level in order to shut off the flame. Replace packing in the packing nut if oil persists in leaking.

When storing an oil stove, be sure to drain out all the kerosene. This keeps water, which is always present to some degree, from settling and causing rust.

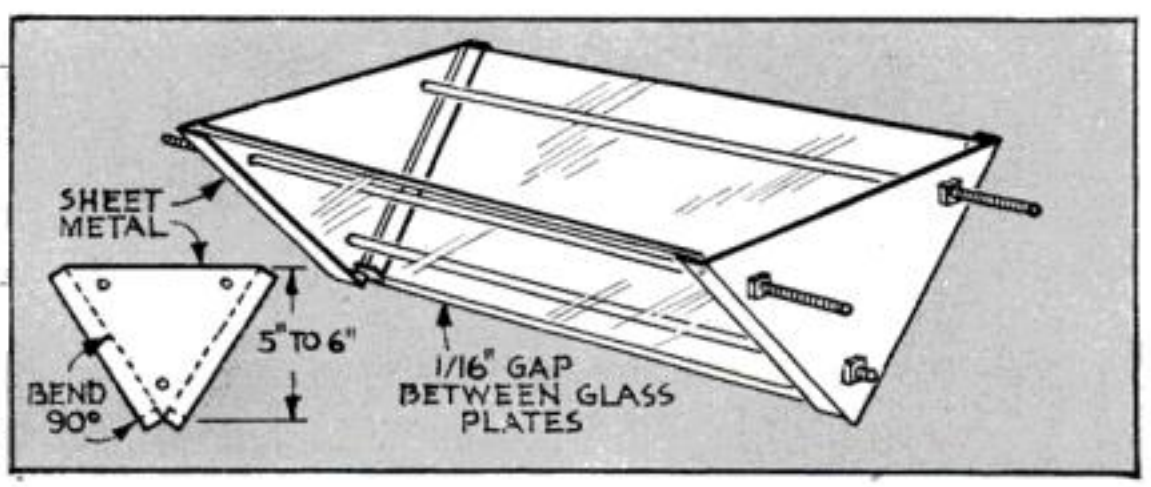
Aquarium "Maternity Ward" Keeps Fish from Eating Its Young



Newly born tropical fish swim into the unoccupied tank through a slot in the trap that holds their mother

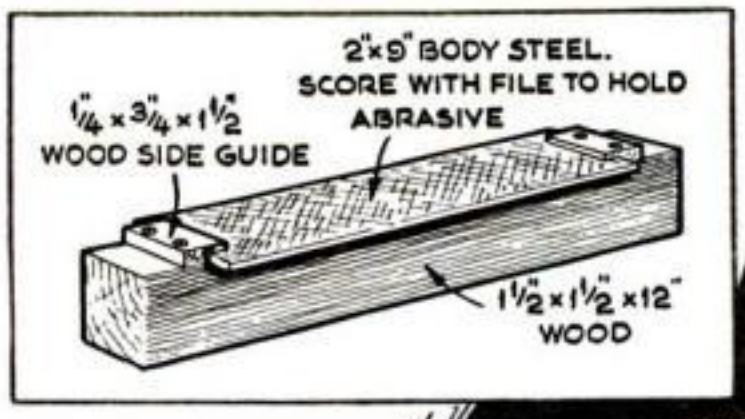
SUSPENDED in an aquarium as shown at the left, this trap allows newly born tropical fish to swim out of reach of their cannibalistic parent. The trap consists simply of two sheets of glass held with three threaded rods and nuts between two triangular metal ends. A gap between the plates lets young fish escape.

Cut the ends, allowing for a water depth of 5" or 6" for the confined mother fish, and drill each for the three rods. Bend the projecting pieces as indicated. Fit in the glass sides, adjusting them to leave a 1/16" space at the bottom for the young fish, and tighten the nuts. The trap is hung across the acquarium, resting on the ends of the upper rods.—CHARLES T. PEARSON.



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Homemade Steel Lap Sharpens Skates with Grinding Compound



RACING-SKATE blades can be kept sharp and speedy if you use a lap made of scored steel, as shown in the drawing. The steel is mounted on a wood handle and held by rabbeted blocks that are just far enough apart to slide along the outside edge of the blades with little friction when the skates are held in a jig.

These side guides keep the lap moving in a straight line and eliminate the danger of rounding the surface of the blades, such as is frequently done when a hone is given a circular motion to prevent wearing grooves. Scoring of the lap helps hold the abrasive.

Lap first with a coarse compound, using plenty of pressure. Finish with a fine compound thinned with oil.—W. A. SMITH.



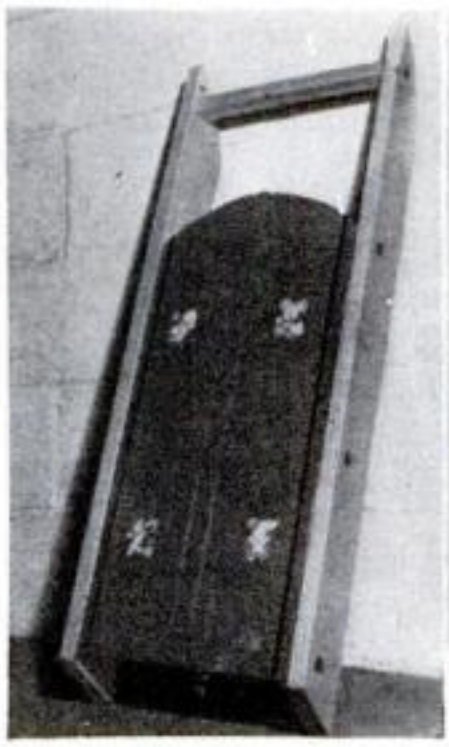
All-Wood Sled Has Serviceable Runners Made of Seasoned Oak

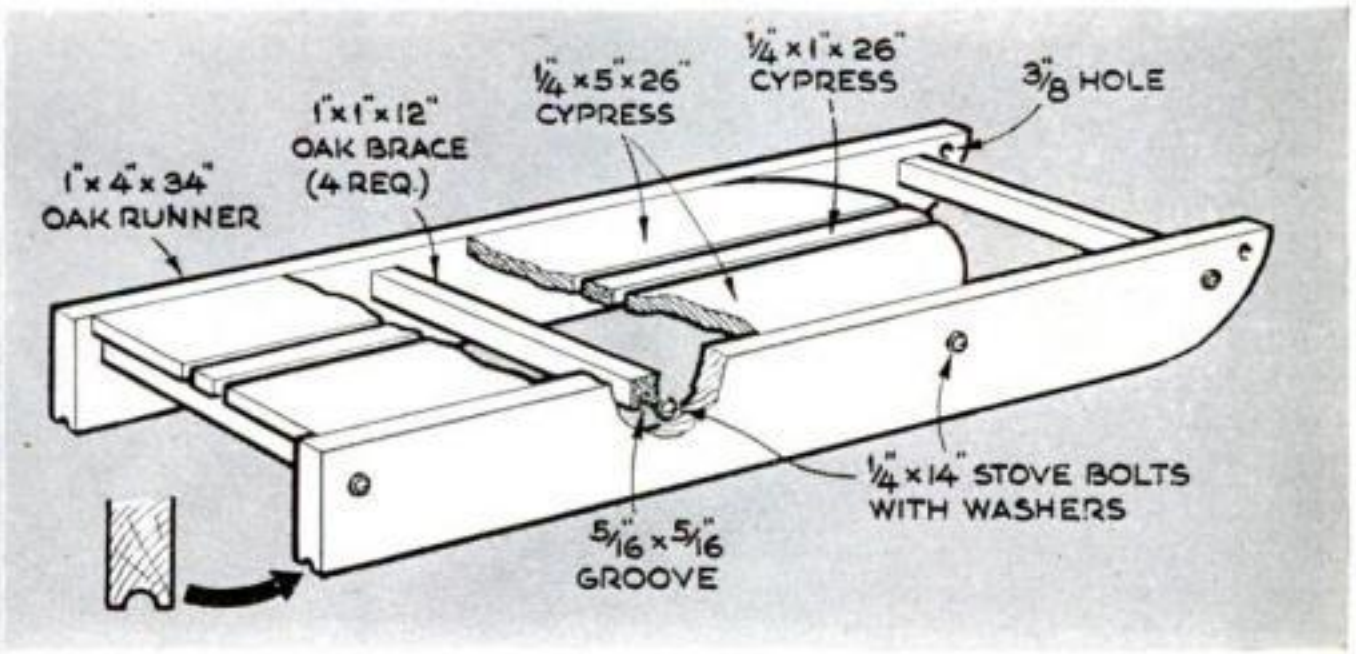
GROOVING the lower edge of the seasoned-oak runners is the secret of good performance by this all-wood sled that will stand rough wear from a five or six-year-old. The bottom of the runners should, however, be given a good coating of wax each day before the sled is put in use. If two lengths of solid-type curtain rod are available, the runners may be shod by mounting the rod in the grooves. This can be done by flattening the ends, drilling, and screwing them.

Stout braces for the runners are made with 1" by 1" oak stock grooved on the bottom edge to take ¼" stove bolts. This design permits placing the braces high enough on the runners to keep them from dragging. The cypress slats that form the body of the sled are laid directly on three of the braces, as shown, and nailed to them.

If you have power tools, the project should take but an evening, though construction is simple enough with hand tools. Saw the back of the runners straight or at an angle, and saw, plane, and sand the fronts to shape. A dado blade can be used for roughing out the grooves; or their sides may be cut on a circular saw set to proper depth and the centers then chiseled out. They also may be cut by chisel alone after being laid out with a marking gauge.

The top of the sled shown was enameled a bright red and decorated with decalcomanias, while the runners and braces were left unpainted. Give the entire sled a sealing coat of shellac or a shellac substitute, and then put on a finishing coat of clear varnish. Two ⅜" holes at the front of the runners take a rope for pulling.—W. A. CRUME.





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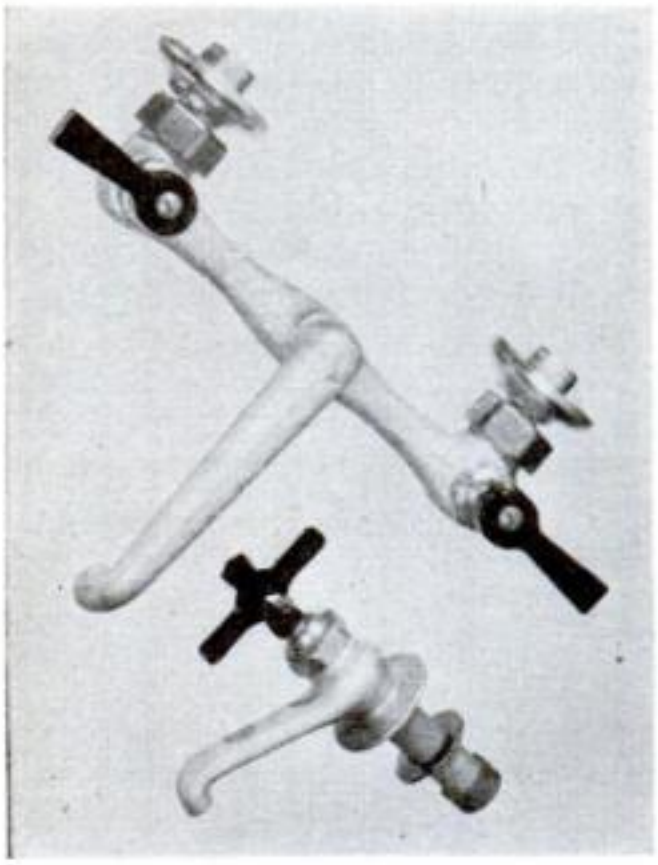


CARPENTRY CALCULATIONS and such characteristics as hardness, weight, shrinkage, warping, and ease of working various woods are shown on a dial calculator put out by the Greenlee Tool Co., of Rockford, Ill. Nail and screw information, tool-sharpening tips, and a protractor are also included.





KITCHEN CABINETS in sink, base, wall, and utility units are now available singly or in combinations. Factory built by the Kitchen Maid Corporation, of Andrews, Ind., of hardwood, plywood, metal, and composition, they are finished in white enamel and are shipped ready for installation.



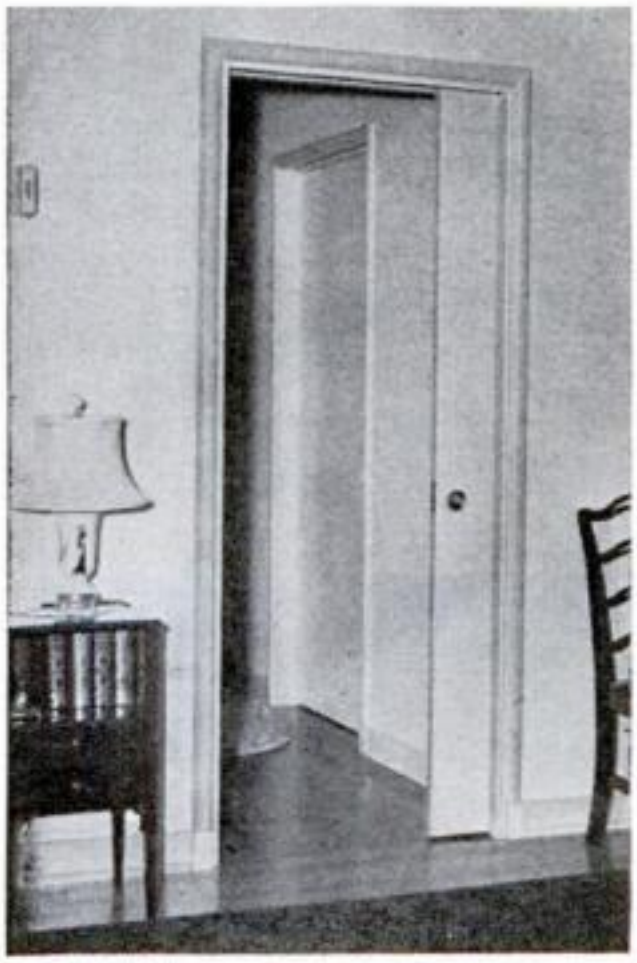
PLASTIC HANDLES for faucets, originally developed for Government housing projects and the U. S. Navy and Maritime Commission, are to be put on the market by the Plastic Die & Tool Corporation, of Los Angeles. They are made of colored Bakelite and do not conduct heat.

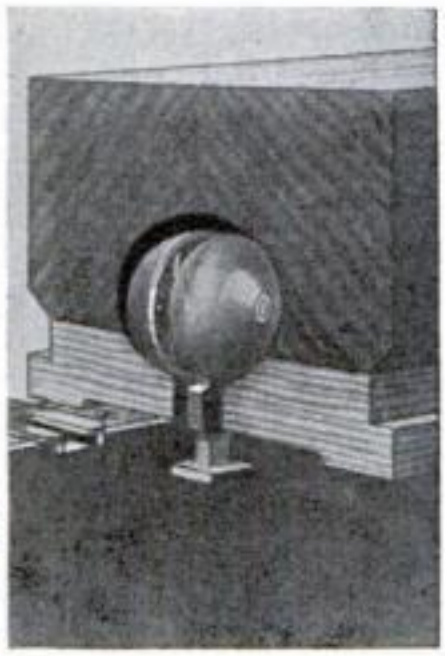
GRATE AREA IS INCREASED and more space for the flow of air is provided by a pyramidal, hollow, perforated grate that is installed simply by setting it in the center of the regular furnace grate, as shown below. The result, according to the makers, Albert Lea Foundry Co., of Albert Lea, Minn., is better combustion of coal and gases in a hand-fired furnace. Five sizes are available, ranging in weight from 8 lb. for small domestic water heaters to 34 lb. for furnace grates and boilers 22″ and over in diameter. Oblong units are made for certain kitchen ranges and heaters.



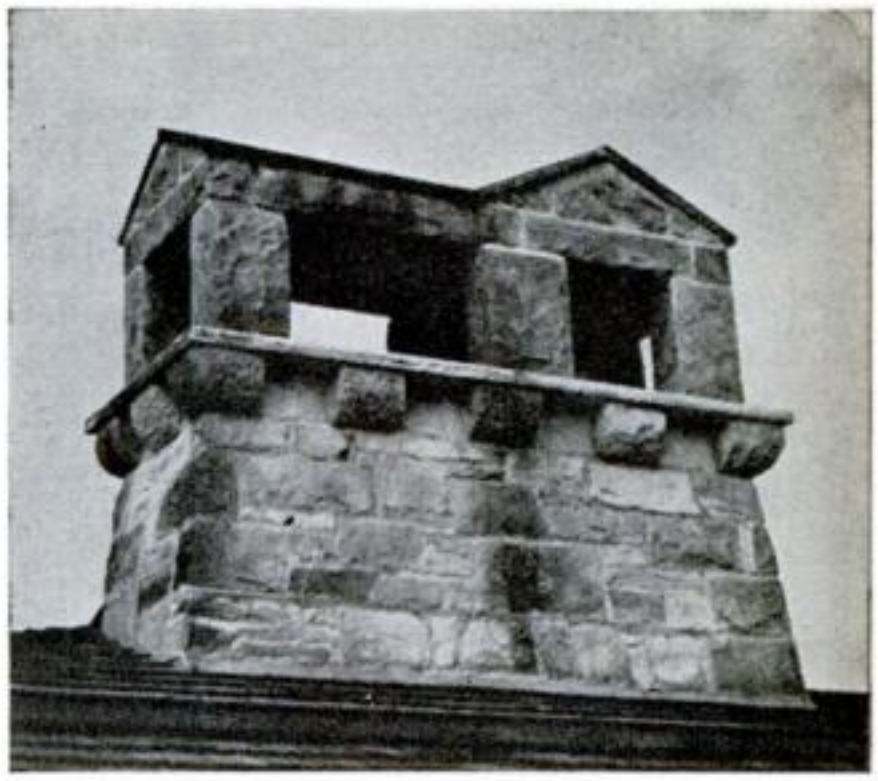
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FACTORY PREFIT DOORS that require no hand trimming for installation are being introduced to the building trade and to home owners. These include both side-hung doors and the overhead-roller sliding door shown in the photo below. Stock doors are now also milled at the factory to specifications of the Fir Door Institute for quick installation of hardware. They are available with hinge gains for either right or left swing.





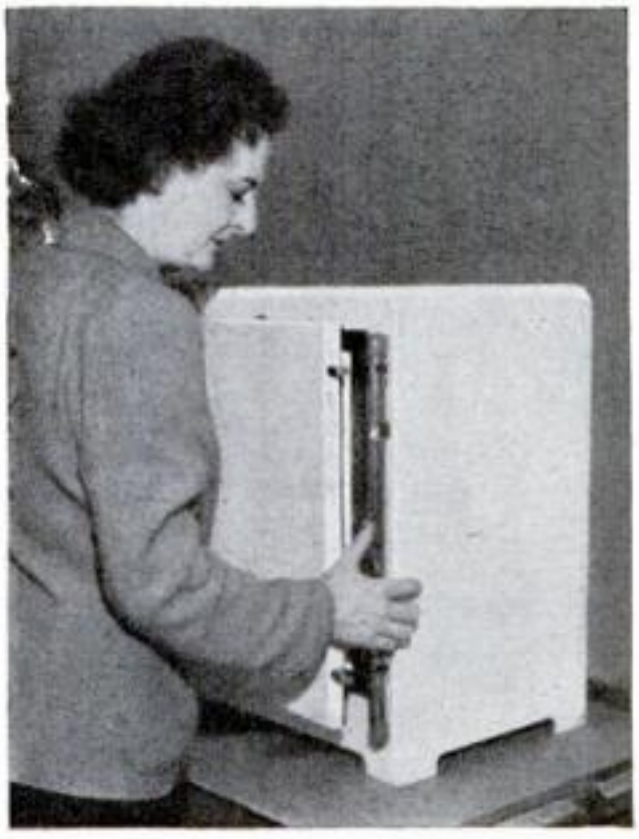
Overhead rollers slide in an improved track made of hardwood for quieter operation, as shown above. Both the header and track come assembled in the frame



FOR A UNIQUE ORNAMENT as well as an efficient chimney cap that lets out smoke and keeps out rain, home builders may take a suggestion from the temple design shown above. It caps chimneys on a shelter house at the Brecksville Reservation of the Cleveland Metropolitan Park District.



COMBINED IN A SINGLE KIT, a dozen handy repair items will take care of hundreds of little and even big jobs that come up in every household. The kit, assembled by Lewis & Conger, of New York, includes adhesives, crack filler, rust-proofing material and rust remover, a self-indicating fuse, and a powder for welding together broken electric heating elements. A strong putty knife is also in the kit.



DOORS OPEN either to the right or left with a combination hinge and latch shown in operation here on a model refrigerator. Both sides of a door are fitted with the units. To open it, simply press on a button at the center of one hinge. This releases that hinge, and the door swings open on the other. The device, developed by the Crosby Research Foundation, might be of value on many kinds of household doors.



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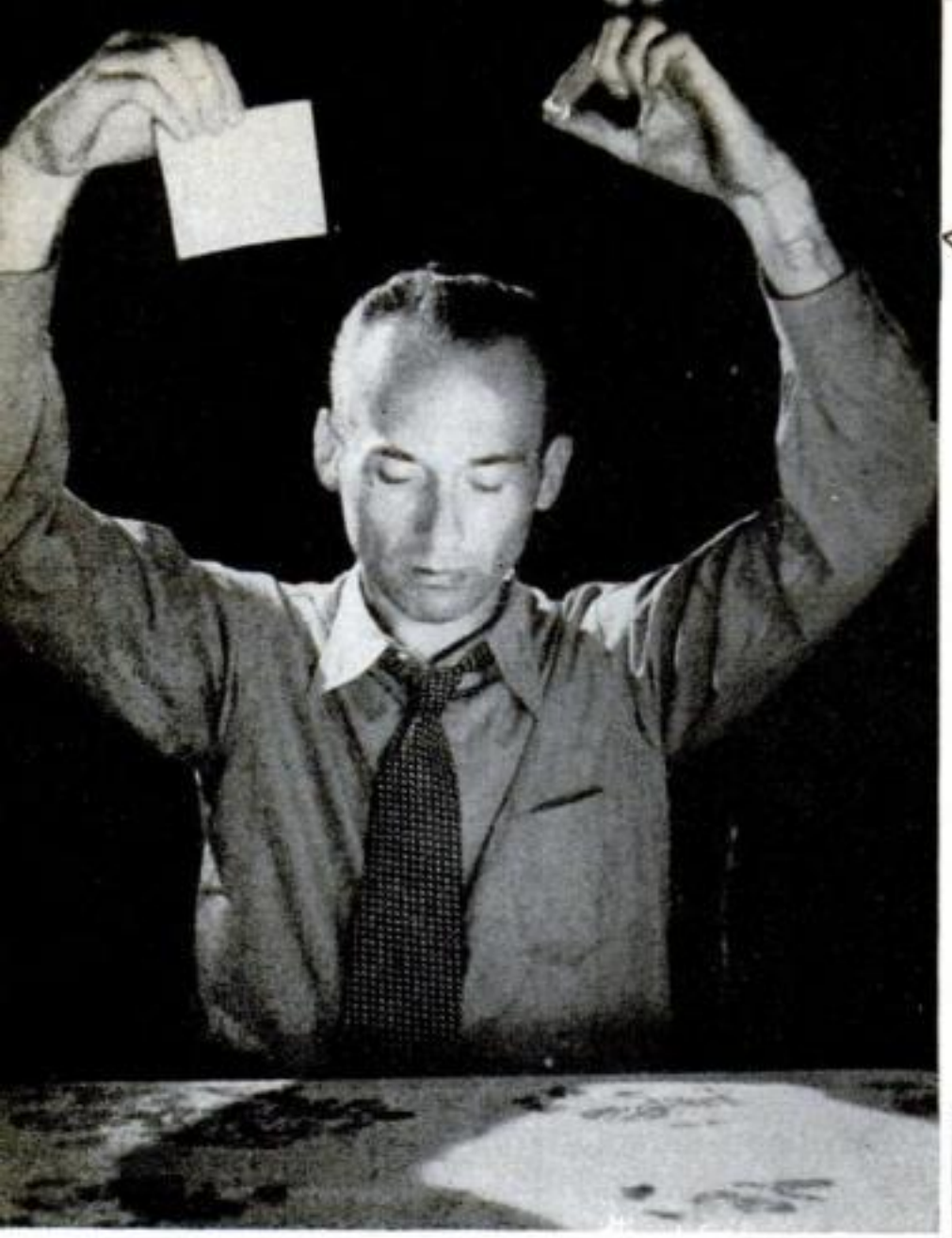
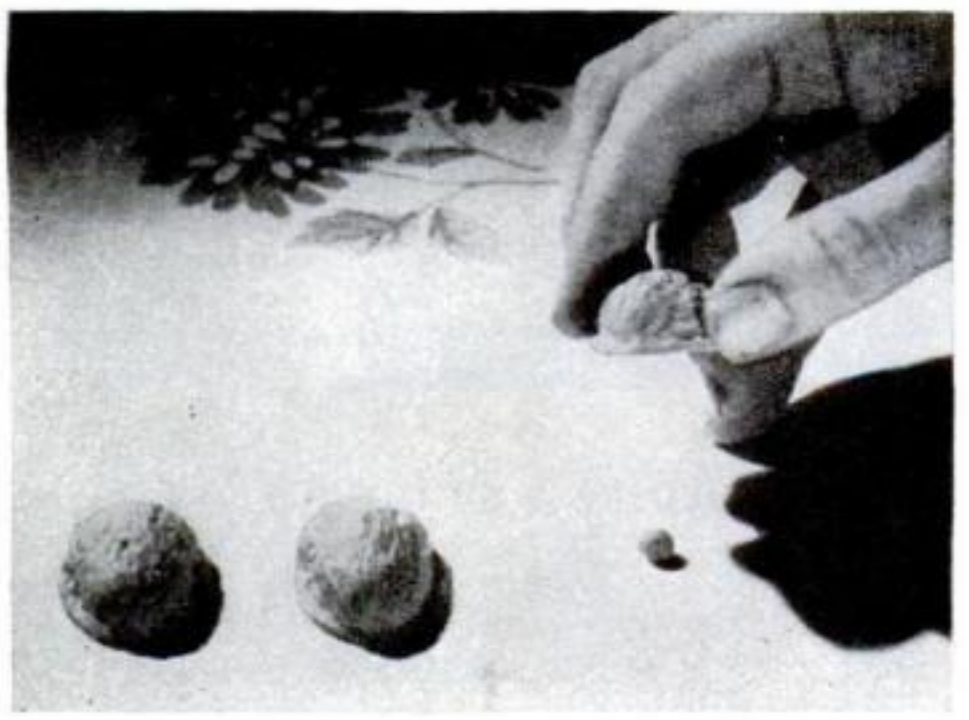
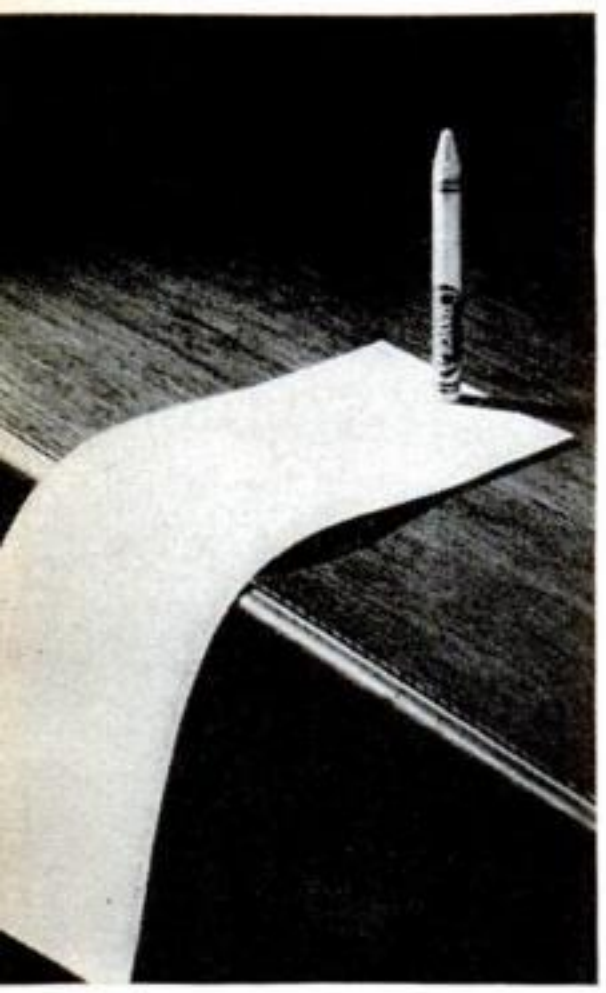


TABLE TRICKS

THAT OLD SHELL GAME can be worked with professional skill if you practice a little beforehand. Put a pea under the middle one of three half walnut shells on a covered table and move each shell about 3″ to the left. You can then—if you have been skillful enough to extract the pea unnoticed and hide it between your thumb and middle finger—make the pea appear from under any shell that is named! The pea should be cut out of a green eraser or other soft rubber. In sliding the middle shell, squeeze the pea out under the back. To make it reappear, drop it as you pick up a given shell.



WHICH FALLS FASTER, paper or a marble? The marble will, of course, if the paper is held as above; but can you hold a 3″ square piece of paper and a marble so they will drop to the floor or on a table at exactly the same time? Certainly you can—if you know your Galileo! Roll the paper into as tight a ball as possible and hold it and the marble at the same height. Remember how Galileo proved, at the Leaning Tower of Pisa, that but for air resistance all things would fall at the same speed?



JERKING A PAPER from under an upended crayon without upsetting the crayon looks like a difficult trick. And it is! You know how to remove a strip of paper from under a glass of water by jerking it. You'll have to be quicker to do this with the crayon. Place the paper as shown at left, hold the end with one hand, and strike it with two fingers of the other hand, bringing them down with a full-arm swing. The crayon should be well balanced, and rather limp paper, such as a strip of newspaper, should be used. A little practice will show you the speed needed to avoid upsetting the crayon.

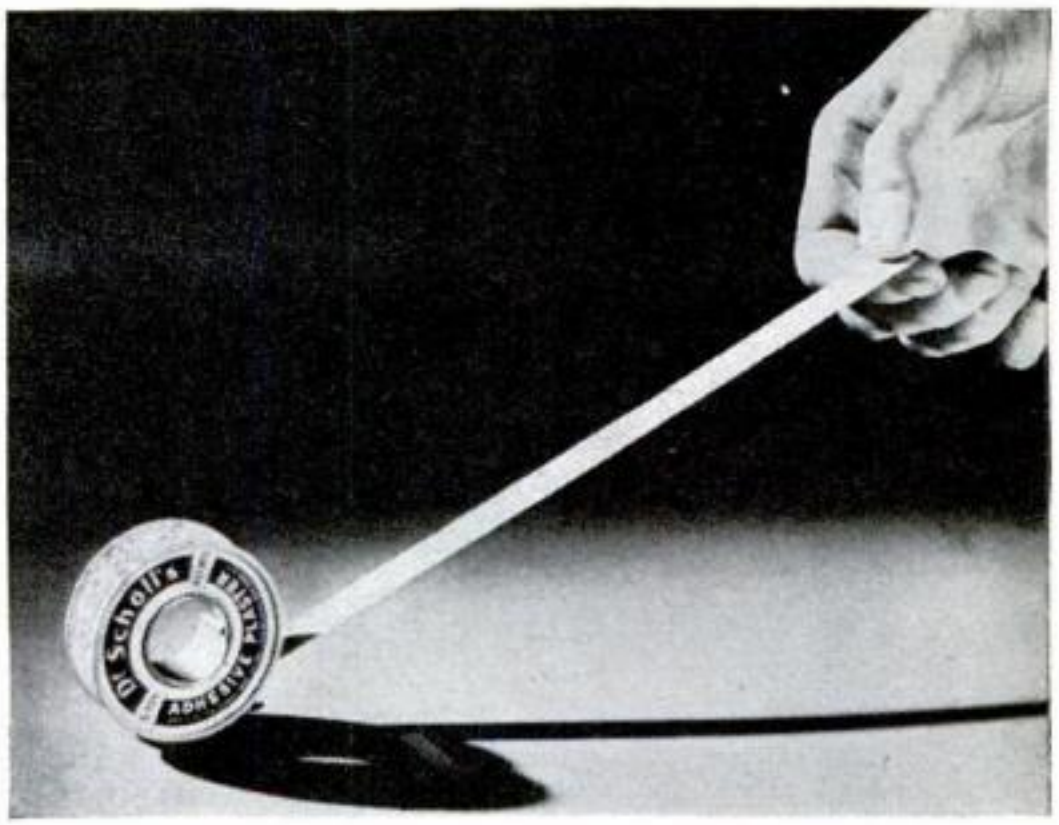
FOR AN AFTER-DINNER TRICK that will end with gales of laughter, borrow a compact or a pocket watch from one of the members of your party, and then proceed nonchalantly to bend it back and forth as if it were rubber. It's an illusion, of course, but a convincing one! Alternately move the compact or watch slightly forward and backward, drawing your fingertips a little apart as you push the piece forward and bringing them together as you move it back. If you use a watch, hold the face toward you.

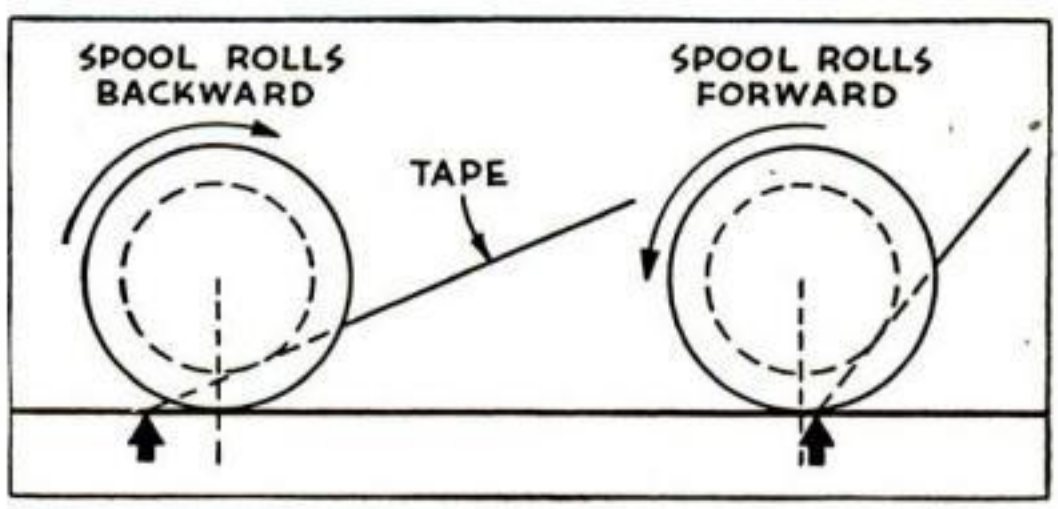


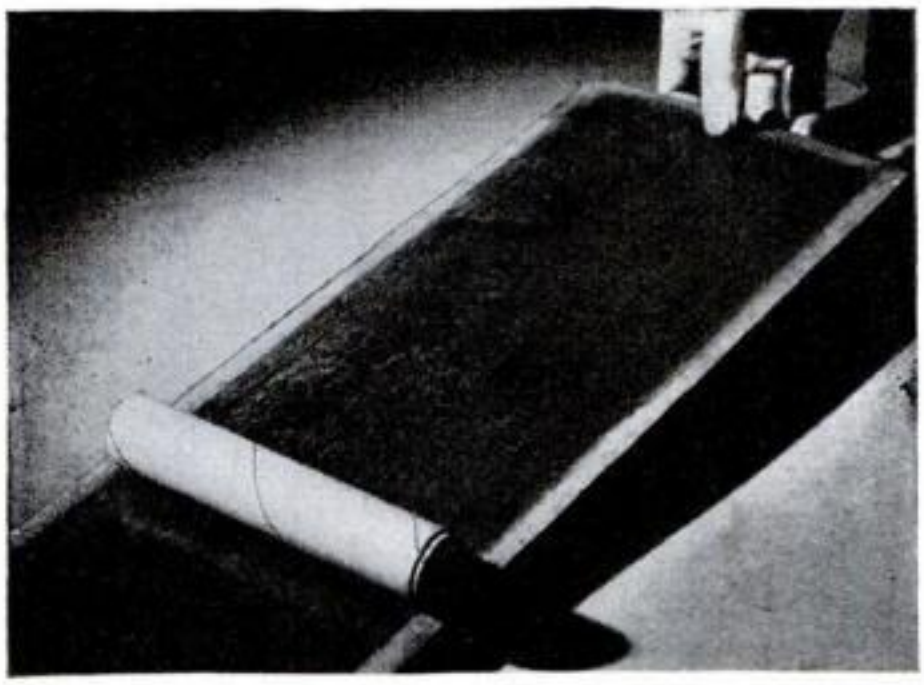
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STRICT OBEDIENCE can be had from an adhesive-tape or typewriter-ribbon spool if you know how to use persuasion along with your command. You can make the spool roll mysteriously away from you, roll as mysteriously toward you, or drag on the table without rolling at all!

Get an empty spool, attach an 18" strip of paper to it, and roll about half of the paper tape on it. Now stand the spool on the table with the strip leading to your hand from the bottom, as shown in the photo. The way the spool will roll depends on the angle the tape makes with the vertical axis of the spool. What happens is shown in the diagrams. If the imaginary continuation of the line of the tape meets the surface beyond the center of the spool, the spool rolls toward you; if it meets on the side toward you, the spool rolls away; at precisely a 45-deg. angle, the spool is dragged without rolling. For the best effect, keep the angle near the critical point so the change won't be conspicuous to others.

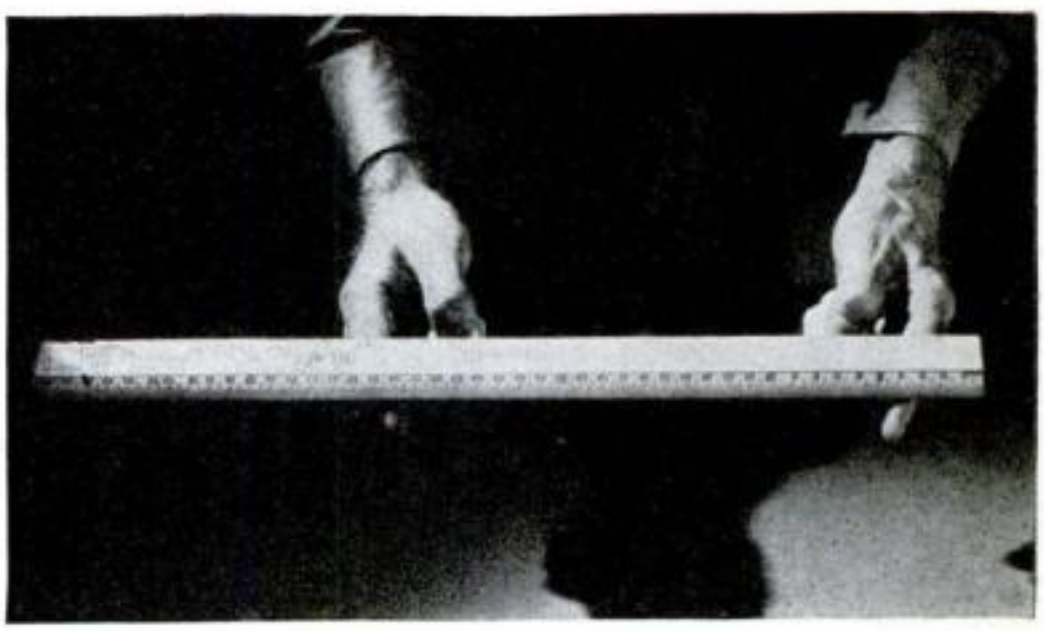






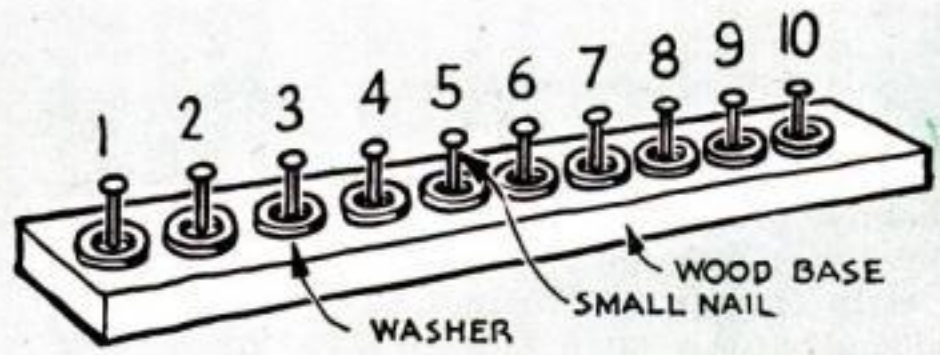
CONTRARINESS IN A CYLINDER rolling down an incline is about the last thing your friends will look for. Instead of picking up speed as it rolls, this cylinder will get off to a good start, only to slow down or even stop dead in its tracks! Use a long, thin, capped can or cylindrical cardboard container. A mailing tube plugged at both ends will do. Then prepare it in advance by pouring in some fine sand or salt, and upend the tube before starting to roll it. As long as the sand stays in the end, the tube behaves normally; but as it rolls, the sand is distributed, adding friction and shifting the center of gravity.

WHICH END OF A RULER or a yardstick will fall if you hold it as shown at the right and gradually draw your fingers toward each other? Your friends will invariably guess wrong, for the ruler won't fall at all! If you move your fingers carefully, they will meet in the center with the ruler balanced on them. The friction of the ruler on each finger will depend on the overhang beyond that finger, with the result that the ruler centers itself over its two supports.



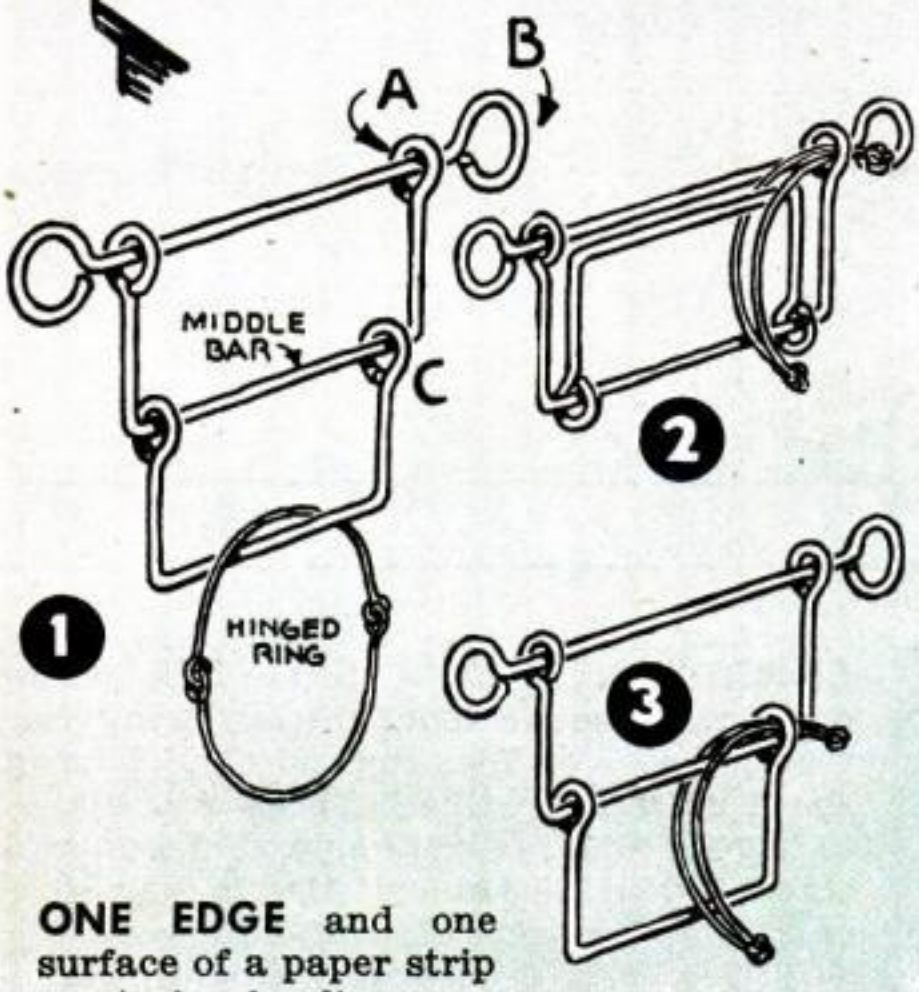
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WITH JUST FIVE JUMPS, always jumping over two nails, can you change the arrangement shown above so the washers will wind up in pairs on alternate nails? It's easy; but if you get started on the wrong foot—or the wrong washer—you may find it a puzzler.

Here's the way it's done. Jump washer No. 5 over No. 4 and No. 3 and place it on No. 2; then jump No. 7 onto No. 10, No. 3 onto No. 8, No. 1 onto No. 4, and No. 9 onto No. 6.



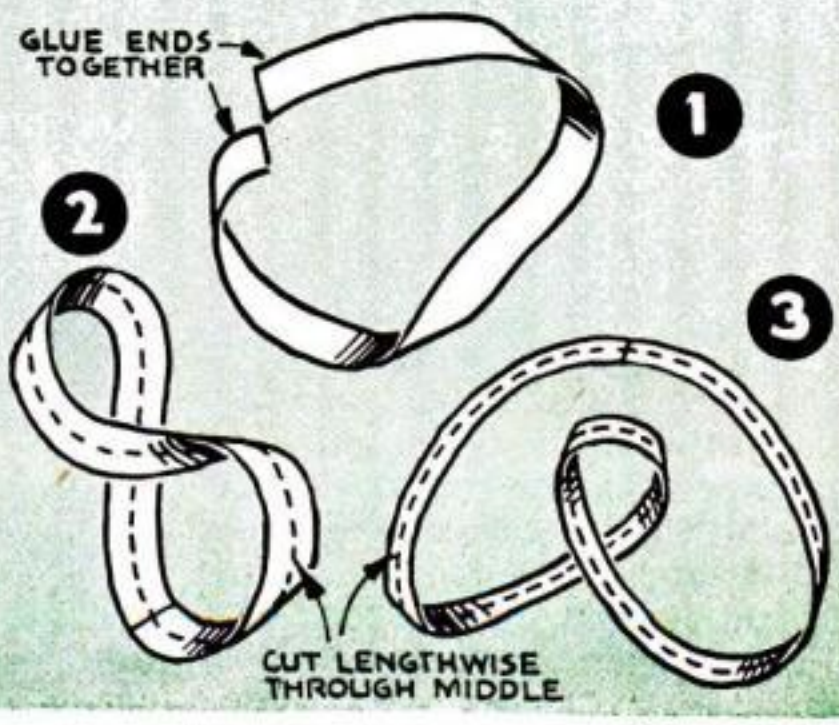
FOR A TRAPEZE STUNT, bend coat-hanger wire into a double trapeze and bend a hinged hoop from smaller-gauge wire. Polish all parts with steel wool and wax.

Set up the puzzle as shown in Fig. 1 at left and ask your friends to remove the ring. When they give up, fold the lower trapeze into the upper, fold the ring double, as in Fig. 2, and push it as far as possible through loop *A*. Next, slip loop *B* down into fold of the ring, and then draw the ring back out of loop *A*. This puts it on the middle bar!

Now draw the folded ring through *C*, as in Fig. 3, move it up to the top bar, push it through *A*, and slip *B* down through the fold again to free it! Reverse the steps to set up the puzzle.

ONE EDGE and one surface of a paper strip mysteriously disappear if you twist and paste it as shown in Fig. 1 at the right. Moreover, you can cut it completely in half and it will still remain joined together!

A strip 2" by 12" is convenient to start with. It has, of course, four edges and two surfaces. After twisting it 180 deg. and pasting the ends together, as in Fig. 1, you will find if you trace along its whole length that it now has but a single edge and a single surface! Cut it in half on the dotted line shown in Fig. 2, and you will still have a single loop, resembling Fig. 3. Then if you cut this geometrical oddity once more on the dotted line, the result will be two twisted loops inextricably linked together. If you once more cut these loops lengthwise, there will be four.



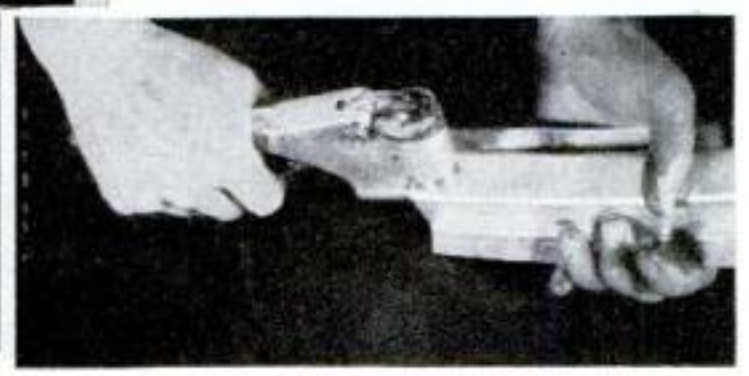
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BETTER PRODUCTION AIDS

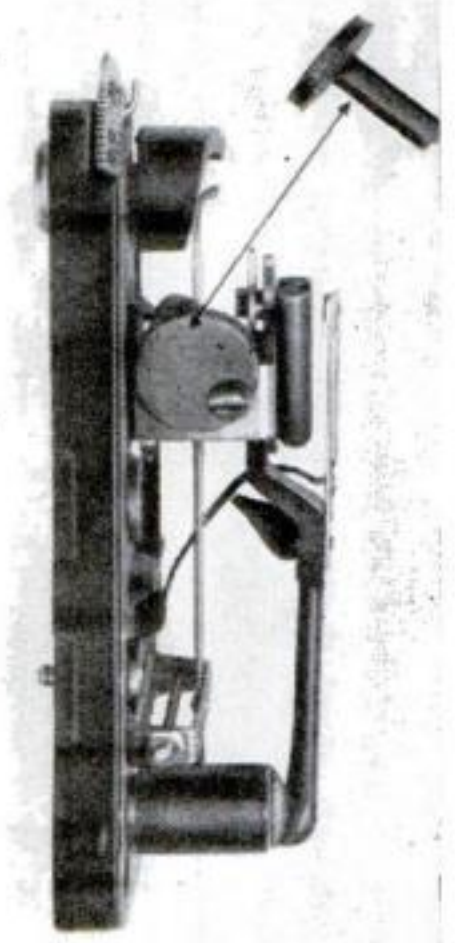


FOOT OPERATION OF A TESTER used to check the hardness of parts in war plants has proved a special boon to women doing this work. The new tester, devised and submitted to the WPB by Stanley Baker, of the Northrop Aircraft, Inc., inspection department at Hawthorne, Calif., operates on the same principle as the hand tester formerly used. Power is supplied by foot pressure, however, as shown in the photo at the far left. This leaves both of the inspector's hands free to manipulate the part being tested, an impossibility when the hand tester was used, since one hand was needed for applying pressure to the tester grips. Baker was awarded an honorable mention in the WPB's production drive for his suggestion of the device.

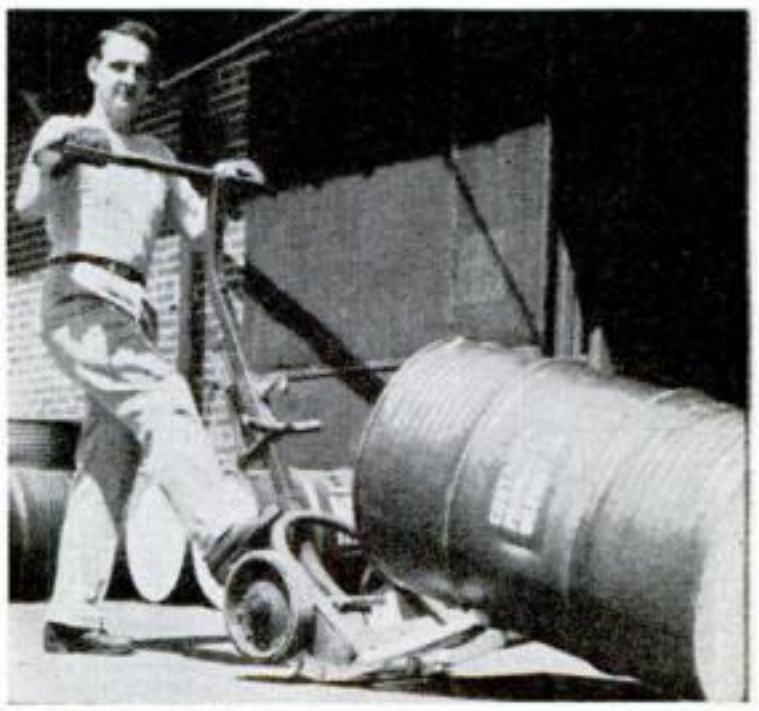
Hand-operated hardness testers, requiring 25-lb. pressure, cramp the hand, as shown below. At the left, pressure is applied by foot



THERMOSTATS that control heating temperatures at the Army post at Fort Sill, Okla., are now furnished with a simple stop that prevents setting beyond a given maximum point. The device consists of an eccentric fiber disk installed on the upright member of the thermostat. Such a disk installed and an extra one are indicated at the right. The stop was devised by Elmer C. Steele, James C. Gelvin, and Hale T. Bush. Costing 50 cents per installation, it is said it may this year save $82,000 in fuel at this post.



UPENDING FILLED DRUMS is a one-man job with the attachment shown below fixed to a hand truck. Its steel bars slipped under a drum ridge, it lifts 650 lb. as the truck is lowered. Two men can lift 900 lb. The idea is that of Alvin H. Potter, a still operator in the Du Pont plant at Toledo, from which plans may be obtained.

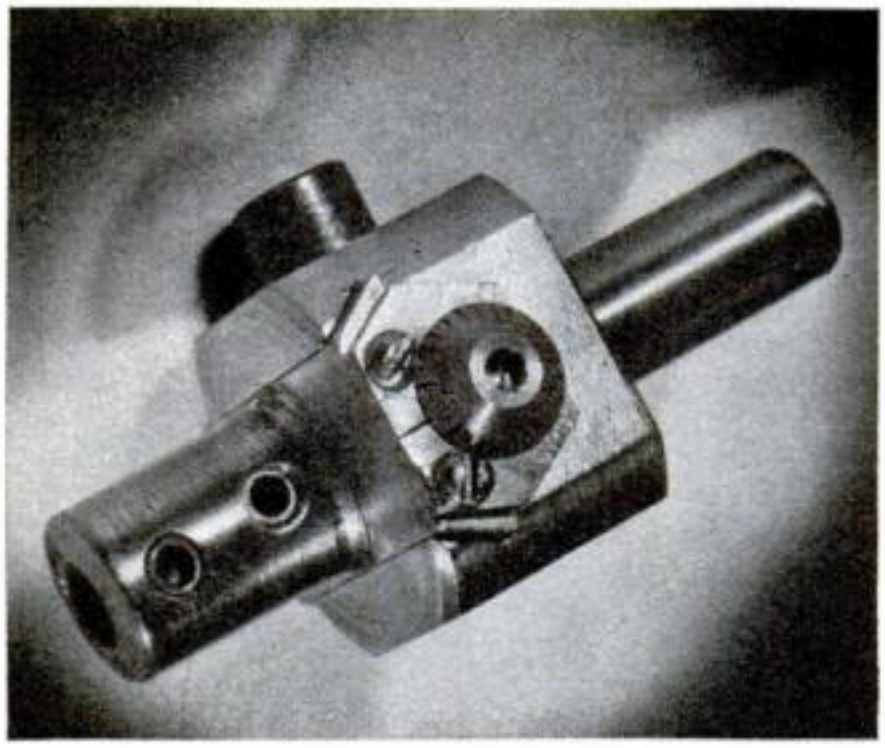


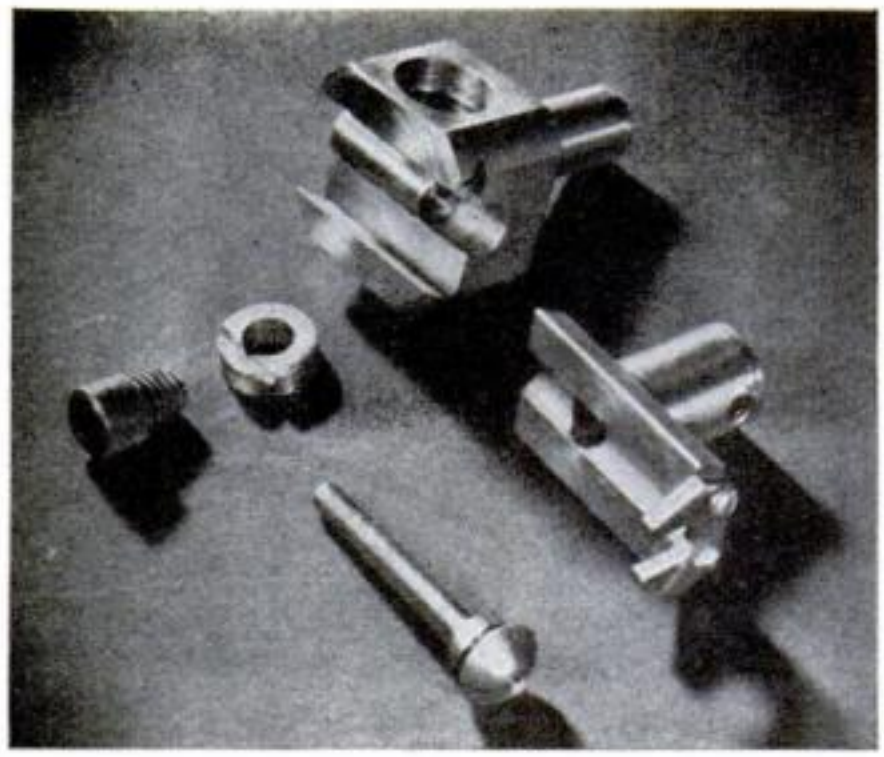


CLEANING THE SURFACE of sheet metal in preparation for soldering is speeded with the use of a sanding disk on an arbor devised for a portable air motor. The method has increased the cleaning operation on tank power trains from 20 to 36 pieces per eight-hour day and increased soldering from 50 to 70 pieces. It was suggested by Milford Heffren of the Caterpillar Tractor Company, Peoria, Ill.



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Eccentric Chuck for Boring Jobs Has Graduated Adjustment

FOR precision boring in the lathe or drill press, this chuck has proved exceptionally useful. With a boring tool made from an old 5/16" reamer, it takes cuts up to .015".

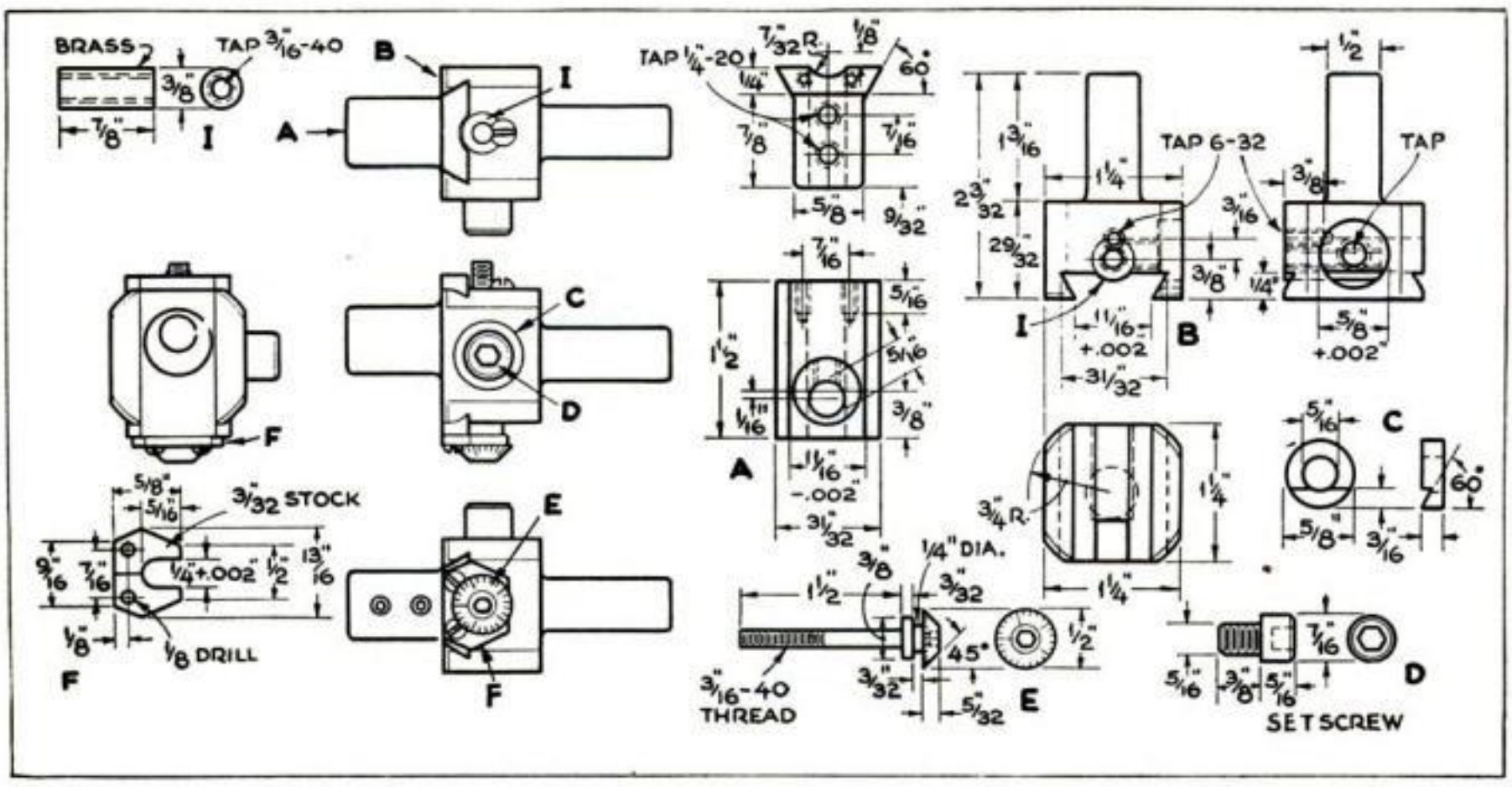
All parts except the bronze bushing *I* are cold-rolled steel. A shank is first turned on the body *B*, which is then filed to shape. Drill a 3/8" hole for the bushing; then cut the 60-deg. dovetail. Drill, tap, and counterbore for the 5/16" setscrew *D*. Insert the bushing and, half in it and half in the body, tap for a 6-32 screw. The bushing must be tapped 40 threads per inch. For the original, a special tap was made, but any 40-pitch tap will serve.

Turn the shank of the slide *A* first; then shape the dovetail. It should be a free fit. File a notch to clear the bronze bushing.

Turn the screw *E* and thread it. Mark the 25 divisions on the head in the lathe or milling machine with an indexing head. In the original, a hole the size of the width across flats on a small hollow-head wrench was drilled in the head. The wrench was then ground flat across the end for use as a broach to cut the corners.

A locking plate *F* is filed to shape and provided with an index mark to align with the head graduations, each of which represents a .001" motion of the slide. The clamping collar *C* bears against the side.

Chuck the assembled piece in the lathe with the body shank running true. By adjusting the screw, set the slide shank 1/16" off center and start the hole for the tool. Remove the slide from the body to run the hole through. Finally, drill and tap for 1/4"-20 setscrews. If staggered rather than aligned as shown, they will hold tool shanks smaller than 5/16".—DONALD ALLAN.

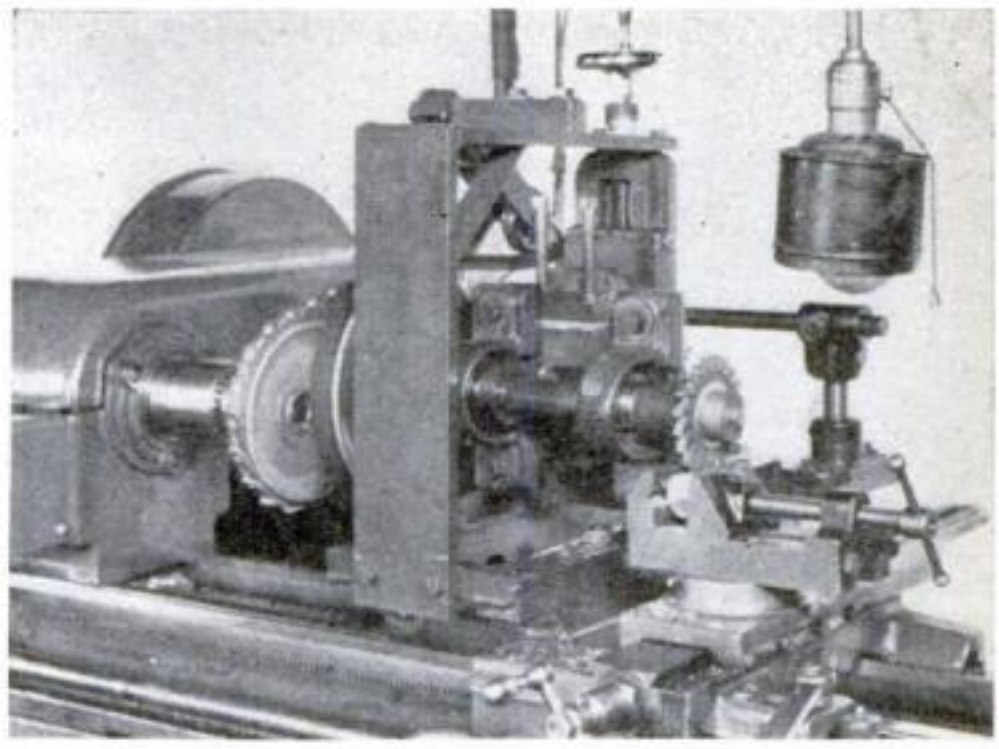


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NEW SHOP IDEAS

PRECISION MILLING in the lathe is possible with the setup shown at right. A milling attachment is used on a lathe-tailstock base. The shaft is turned to house two self-aligning bearings, care being taken so the milling cutter will run true. A round column to house taper bearings would permit handling a greater variety of odd-shaped work. The milling attachment must be mounted so the shaft is at exactly 90 deg. with a cross-feed slide.

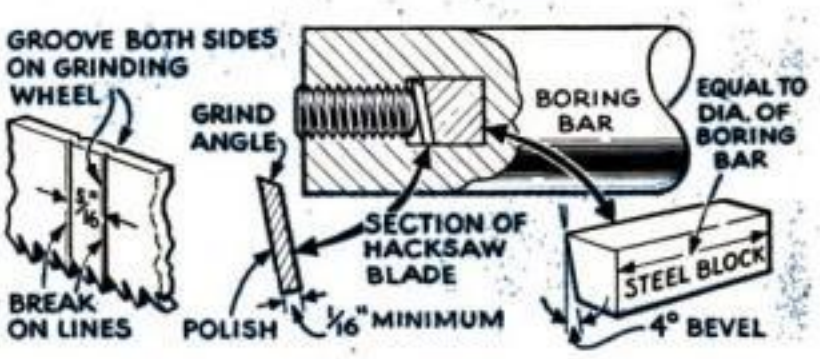
A jackshaft, two self-aligning bearings, four V-pulleys, and a V-belt transmit power from the lathe. The belt is loose enough to fit the milling-spindle and jackshaft pulleys in all ranges. A roller-skate wheel rides the belt as an idler.—AUGUST DOBERT.





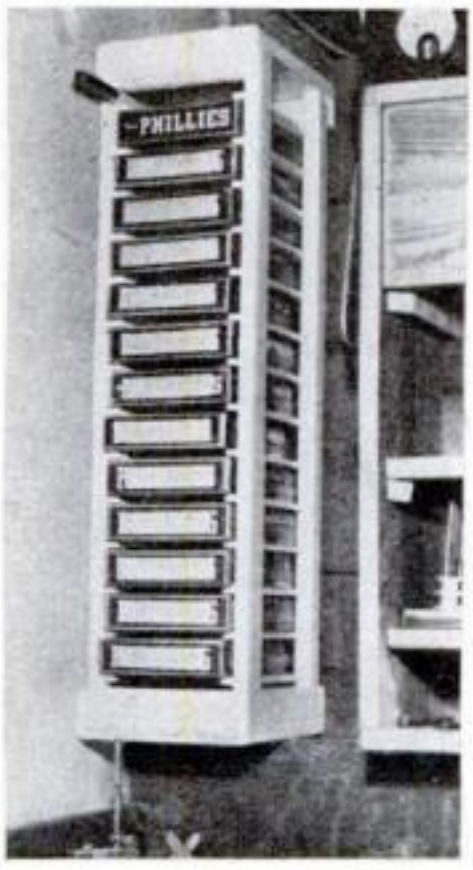
BENCH LIGHTING is supplied adequately with a lamp and stand built from electrical conduit or pipe as shown in the drawing at left. A universal joint held by a single clamp nut permits adjustment of the work light at any convenient angle.

Turn a thin sleeve for this joint from cold-rolled steel and split it lengthwise with a hacksaw. Then braze to it two pieces cut from flat stock, as shown. These are identical except for the 45-deg. counterbore in one. The clamp nut and the two pieces for the lamp arm are turned. Drill the latter two in one operation.—ALBERT H. DOERR.



BORING-BAR BITS that will take a .025" deep cut at a 0.15" feed can be made from power-hacksaw blades. The most satisfactory are high-speed blades of molybdenum steel, which come .065" thick. Broken ones can usually be obtained from a machine shop.

To cut such a blade for bits, grind it on both sides on the corner of an emery wheel and break it in a vise. Cut the pieces slightly large and grind to size on the face of the wheel. A wedge block with a 4-deg. bevel will hold a bit in the boring bar at an angle giving clearance to the front of the tool so that only one face of the bit need be polished.—F. R. T.



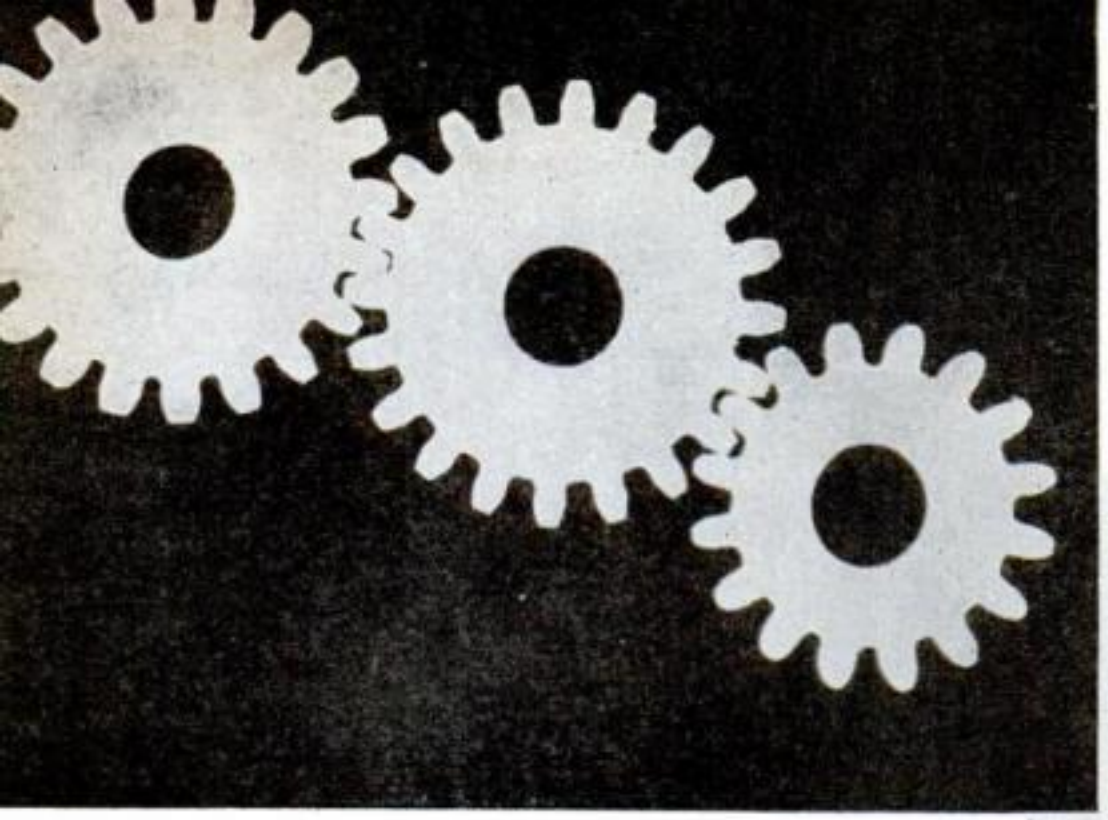
SHOP RACKS for the orderly storage of small parts can be made easily from scrap lengths of wood, as shown at the left. Install individual shelves to hold the customary cigar boxes used in many basement workshops as containers. For neatness the boxes should be labeled and should be of the same size.

The rack shown has four ¾" by 1" uprights with ¼" wide and ¼" deep notches on the inside corners to take the shelves. These are ¼" by ¾" strips glued in. The distance between shelves should, of course, be such as to accommodate the boxes.—J. M.

TWO OLD BELLS from telephone, bicycle, or doorbells will make a convenient container for delicate parts when a clock or other small mechanism is disassembled. File off the riveted stud if necessary and join them with a nail on which shoulders have been filed. Rivet the ends of nail.

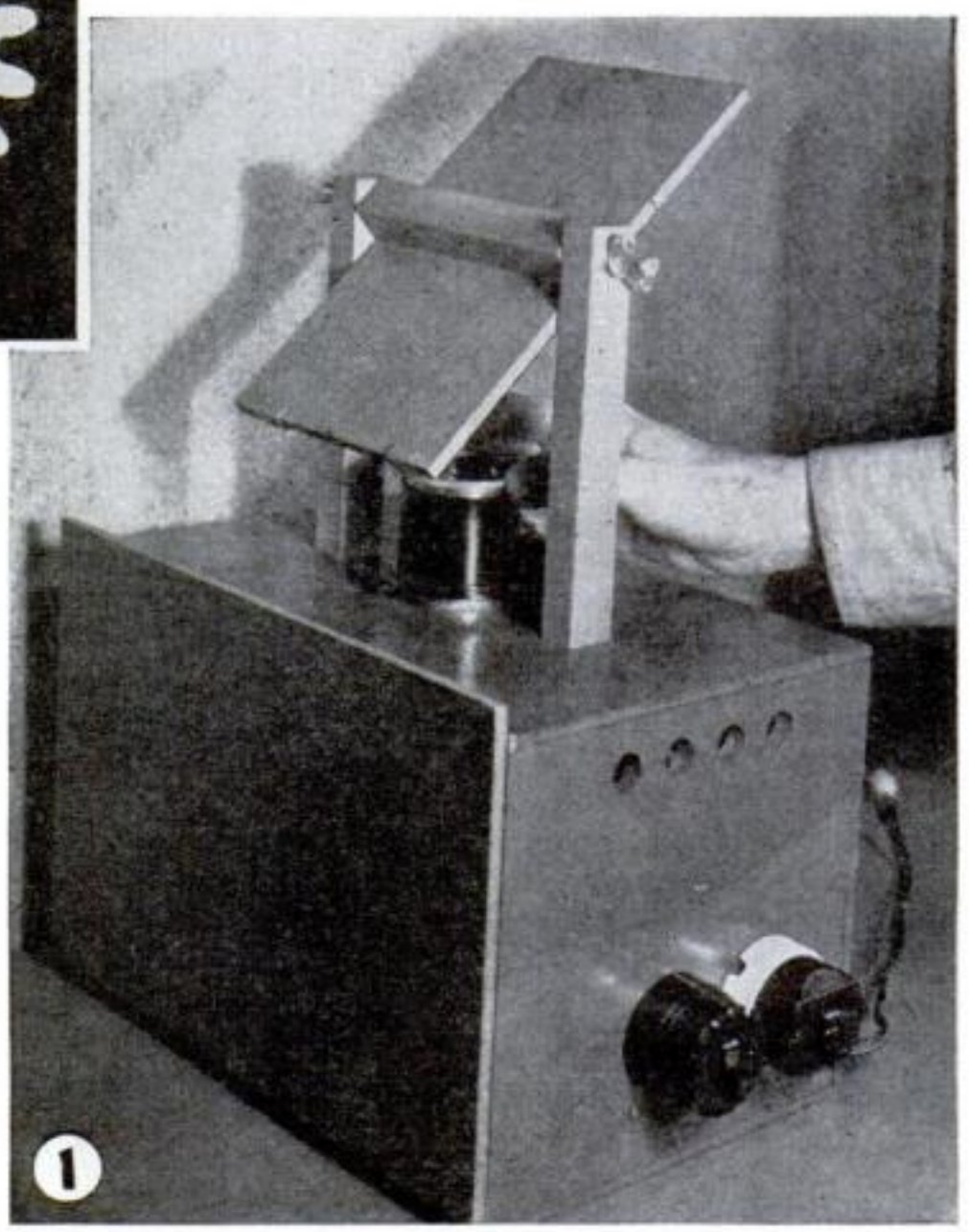


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ALL-PURPOSE

Device Affords Quick Visual



By WALTER E. BURTON

VERSATILITY is the outstanding feature of this projector, which has a large number of uses in the home workshop. Four of the handiest ones are:

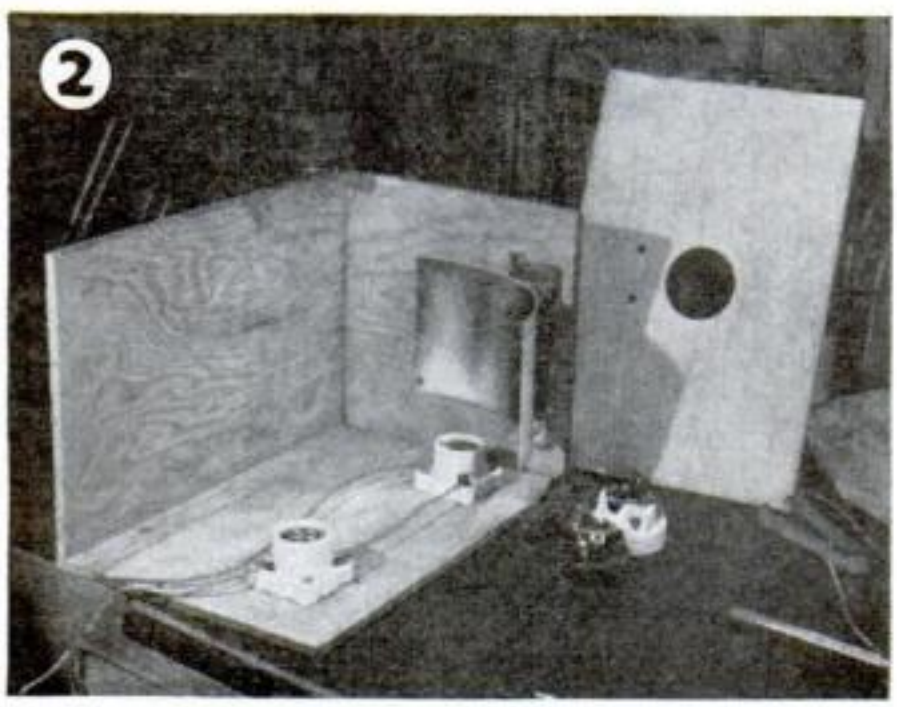
1. Projecting a greatly enlarged contour silhouette of gear teeth, a screw thread, a tap, saw-blade teeth, and the like. This is valuable for determining pitch, detecting wear or flaws in the mesh of gears, and measuring angles or diameters difficult or impossible to measure in ordinary ways.

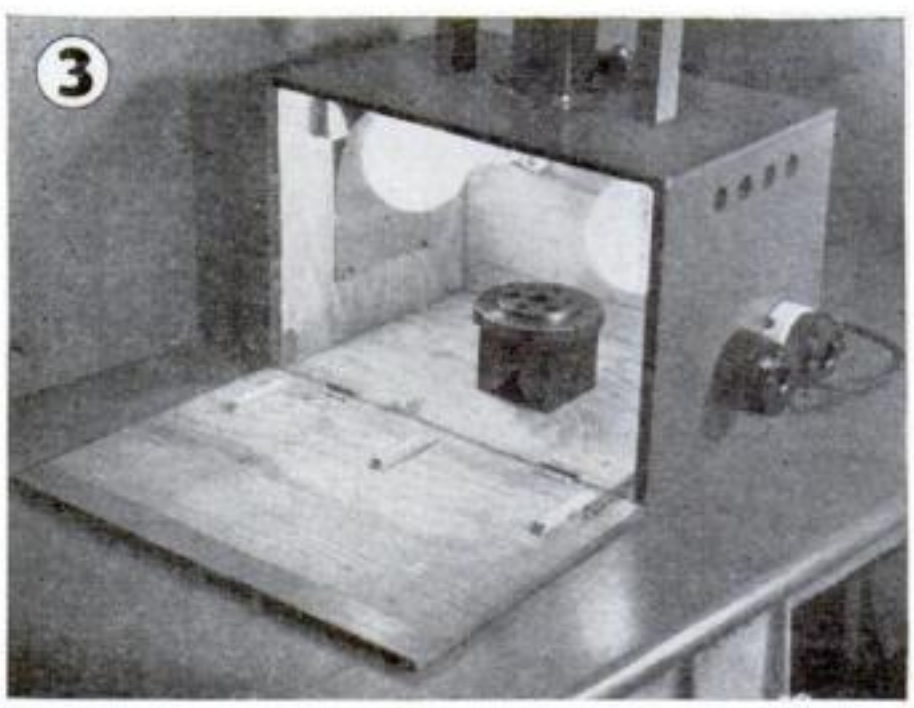
2. Obtaining an enlarged image (not a silhouette) of punches, dies, engraved or stamped surfaces, and machined parts, to examine for defects, to measure to an accuracy of .005", and to compare closely with master drawings.

3. Transferring directly to a piece of stock placed in the screen position the enlarged outline of a scale drawing or pattern.

4. Projecting on sensitized paper the image of an important piece of work so as to preserve a permanent record; and also copying drawings or printed matter to be kept.

The instrument shown in Fig. 1 is really two projectors in one. First, it works like the familiar magic lantern to throw on a screen the image of a surface; and secondly,





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SHOP PROJECTOR

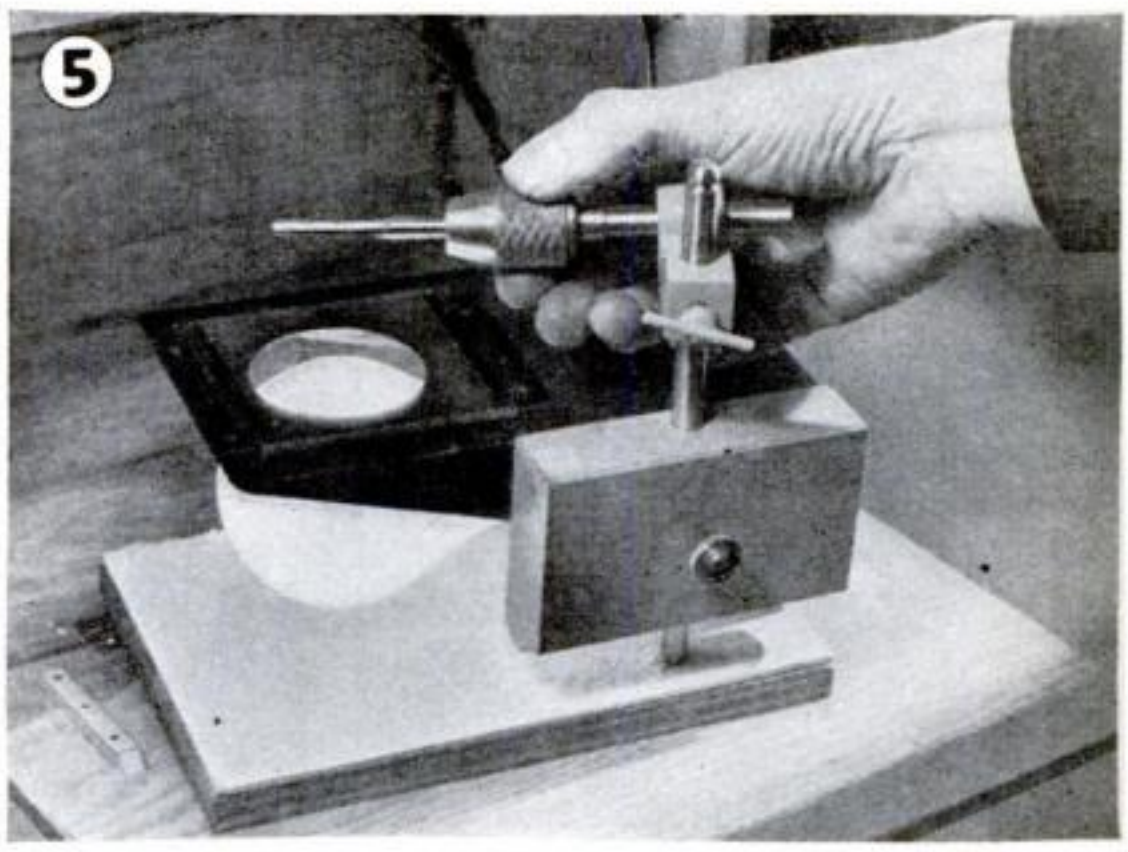
Means of Comparing and Measuring Small or Intricate Work

with a simple auxiliary unit, it is changed to a contour projector, which will throw on the screen the shadow of a thread, gear, or the like. If made of plywood, the projector is suited only for intermittent use (all that is likely to be given a home-workshop instrument), but it could be insulated with asbestos or built of sheet metal to permit continuous operation with high-intensity lamps.

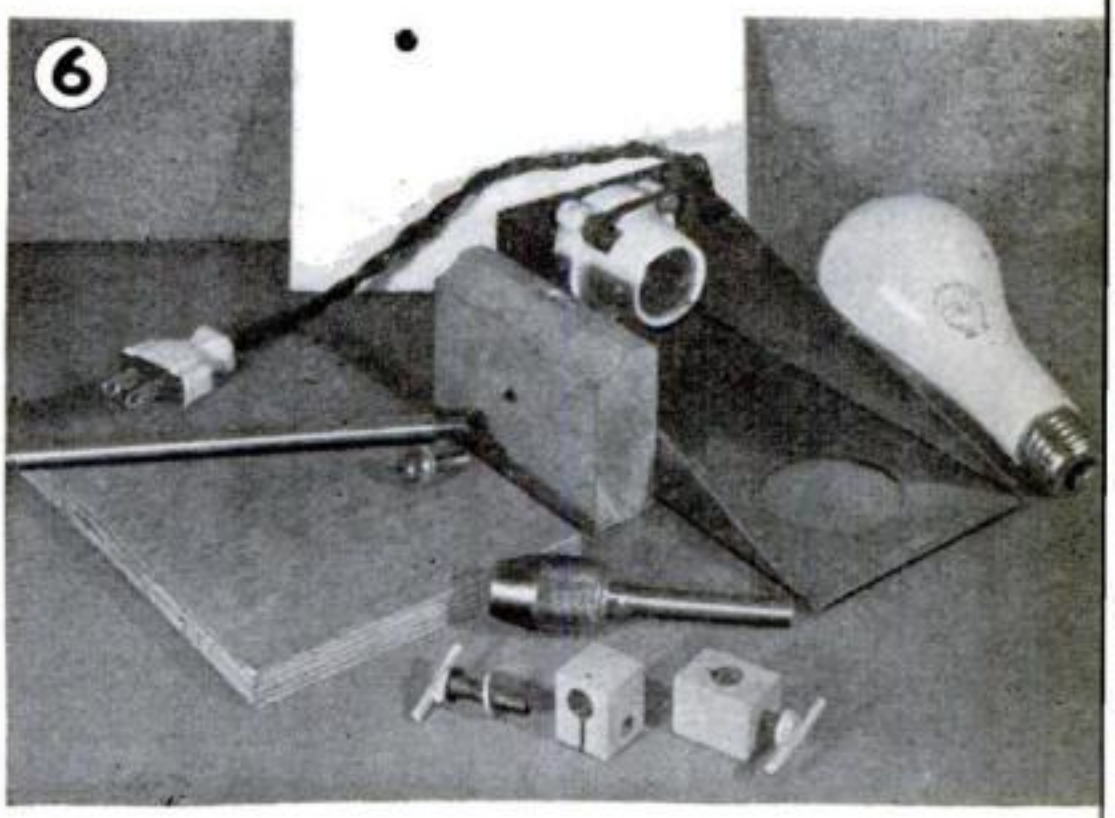
To obtain a sharp, undistorted image on the screen, use a corrected lens and an optically flat mirror or prism. A lens having a focal length of 5″ to 8″ will do. Any good anastigmatic camera or enlarger lens in this range, and having an aperture of f/4.5 or larger, will give good results. A projector lens taken from an old magic lantern may also be used, provided it is of satisfactory quality. In selecting your lens, remember that the greater the aperture, the brighter the image will be but the shallower the depth of focus. In general, the longer the focal length, the larger the field covered by the lens will be, and the shorter the focal length, the greater the magnification.

The lens must be placed in a focusing mount at the top of the projector housing. The simplest way, perhaps, is to attach it to the upper end of a tube that slides within another tube fastened to the top of the lamp house. A spiral groove cut in the sliding tube and a pin mounted in the fixed tube will permit the lens to be focused with accuracy.

Above the lens a mirror or prism directs the image horizontally and also reverses it so that it appears in the normal position on the screen. A 90-deg. prism of the type used on photostat cameras is excellent but not easy to obtain; an ordinary plate-glass mirror, though prone toward "ghost images," is fairly satisfactory; and a first-surface mirror of optically flat glass, Fig. 4, is about as good as the prism. If you plan to reproduce contours exactly, you must of course have a screen image that is free from distortion. One easy way to test your lens and mirror system is to project a series of crossed lines that form a checkerboard grid; by laying a straightedge on the screen image, you can detect any seri-





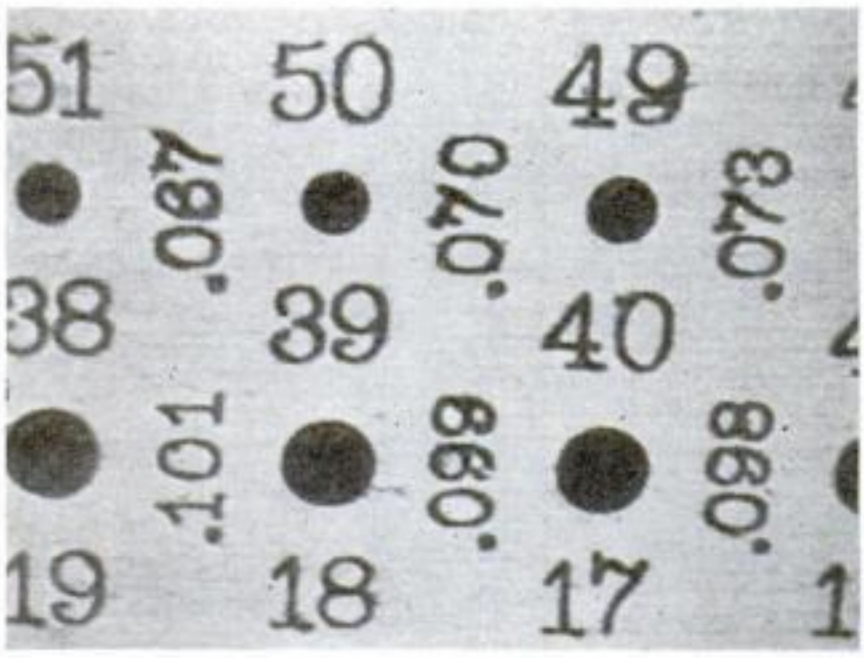


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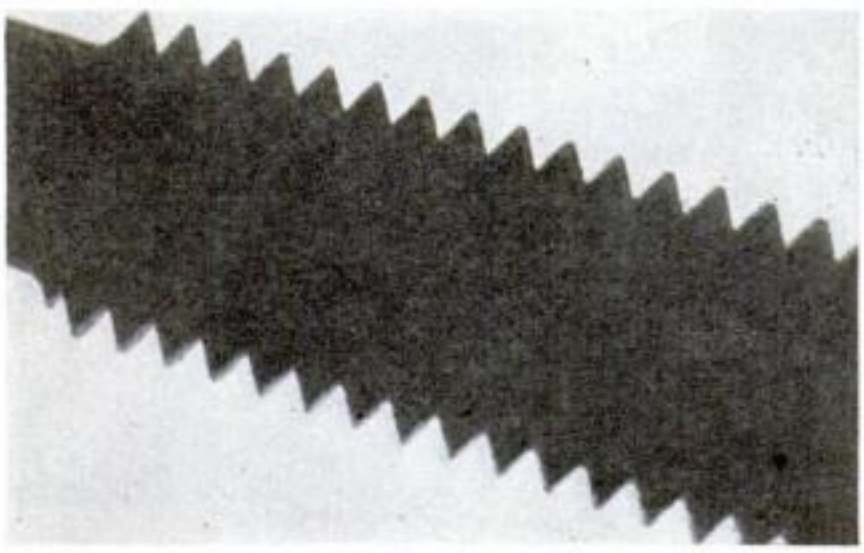
ous lineal distortion in the projected view.

The housing, a plywood box with the back hinged to permit insertion of the work, measures 8" by 8" by 12" on the inside. In determining the height of your projector, it's a good plan to add together the focal length of the lens, the greatest height of the work to be handled, and 1", though if the lens tube is long this can be reduced.

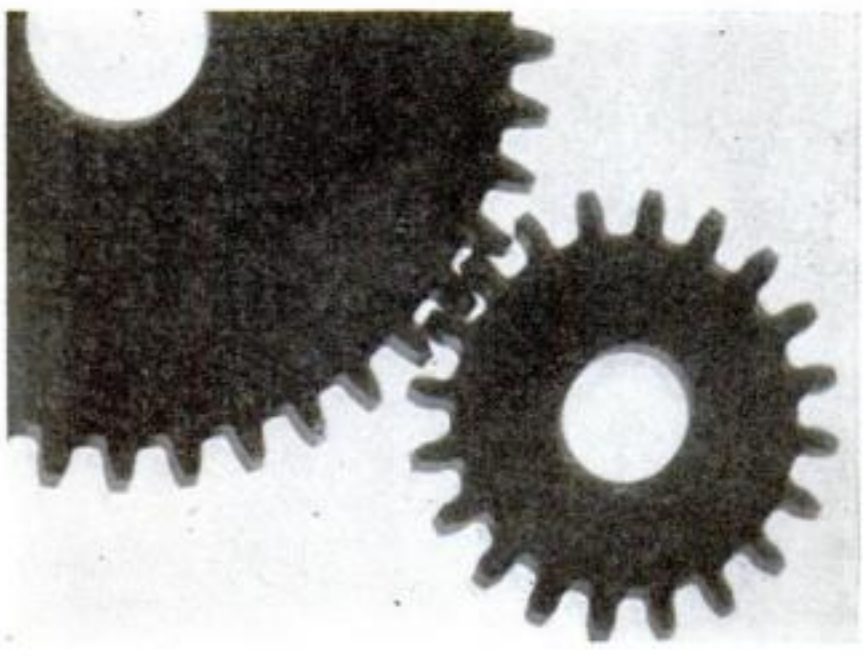
On the inside of the front wall of the housing mount two porcelain sockets, centered about 2¼" from the ends and the top. Cut two 5" or 6" pieces of bright sheet metal to serve as reflectors and tack them

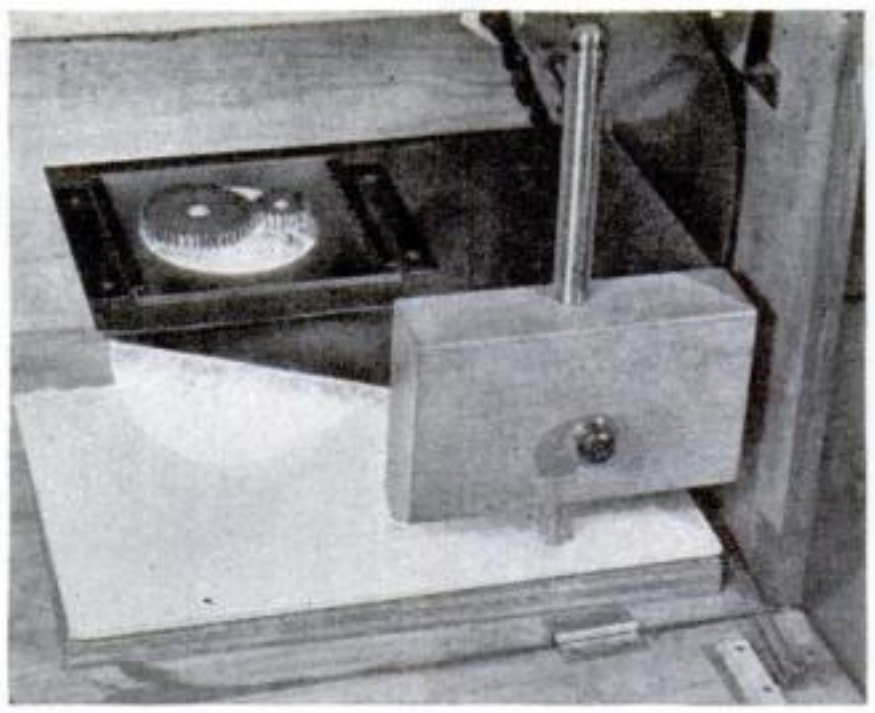


This shows a reflected image of a wire-drill gauge



Above, outline of a ½"-13 tap. On the screen, the image was magnified 10 times. Photo below suggests how carefully the mesh of gears can be scrutinized





Here is the contour-projection unit in position in the housing. A chuck isn't needed with these gears

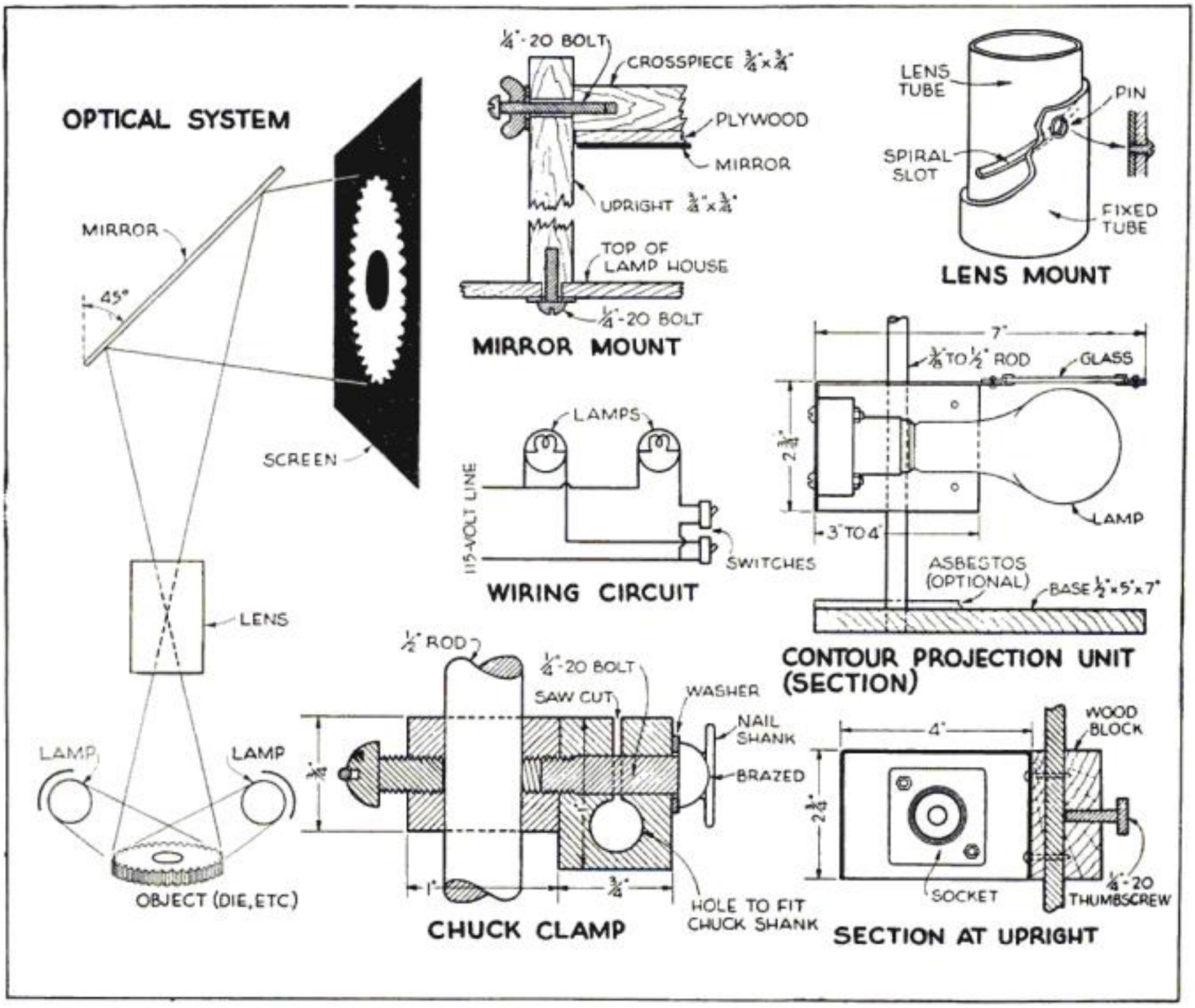
to the sides and top so that they will direct light to the area immediately below the lens. Behind them bore a row of ¾" holes to serve as vents. If the projector heats up excessively, bore two more rows of vent holes near the bottom of each side, attaching sheet-metal light baffles if needed. The placement of sockets and reflectors is shown in Figs. 2 and 3; note that in the former photo the projector is lying on its front.

Two 100-watt lamps, controlled by separate toggle switches, will serve as the light source for most work, giving satisfactorily bright images of steel surfaces at magnifications up to six or eight diameters. Two No. 1 photofloods will provide all the light needed for almost any job, but possible overheating must be kept in mind. It's a good plan to use a photoflood in one socket and a 100-watt lamp in the other; this will enable you to use the latter alone for focusing and the two together for examination.

A screen having good reflection qualities may be made by coating a smooth, flat piece of composition board with white casein paint. If you plan to use the projector for measurements, rule the screen into equal squares or provide it with crossed scales. To calibrate the instrument, a scale divided into, say, tenths of an inch is placed in the projector in the same horizontal plane as the object to be measured, and the lens-to-screen distance is adjusted until the scale marks coincide with the lines on the screen. Then the dimensions of the work can be read at a glance; at a magnification of 10 diameters, each inch on the screen would represent 1/10" on the work. By holding a ruler against the screen, you will be able to measure accurately to .005."

To get contour (silhouette) projection—which is exceedingly useful with gears, taps, and the like—you will need a separate unit (Figs. 5 and 6), that fits inside the projector. It consists of a wood or metal base hav-

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ing an upright on which is mounted a block holding a socket, and, above this, a shelf containing a glass disk on which gears and the like may be laid. A short extension cord fitted with a two-prong plug allows the unit to be connected into one of the regular lamp sockets. A ¼"-20 thumbscrew, tapped into the hardwood block, locks the lamp and shelf in position on the upright. Directly over the lamp, centered with respect to the filament, is a 2" hole cut in the sheet-metal shelf, and over the hole a piece of glass is mounted.

Since objects such as taps are difficult to support by resting them directly on the glass, it's best to use a chuck that is also clamped to the upright. A method of constructing a swivel clamp from ¾" bar stock is shown in the drawing.

Make the contour unit to take an opal bulb of the type used in enlargers, or if this is unavailable, a 100-watt household lamp. To use, place the work on the glass or in the chuck above the glass, slide the shelf or chuck up and down until the screened silhouette is reasonably sharp, and then focus for maximum sharpness by adjusting the lens. If you find "ghost images," that is, lighter silhouettes around the edges of the outline, the chances are that they are caused by double reflections from the mirror, though they may be traceable to diffusion from the opal-glass bulb. However, you can usually disregard these secondary images, making measurements and comparisons from the outline image only. In cases where the utmost sharpness is essential, such as when projecting an image on sensitized paper for making a record, either remove the mirror and project the image directly on the paper thumbtacked to the ceiling, or else turn the instrument on its side like a horizontal enlarger.

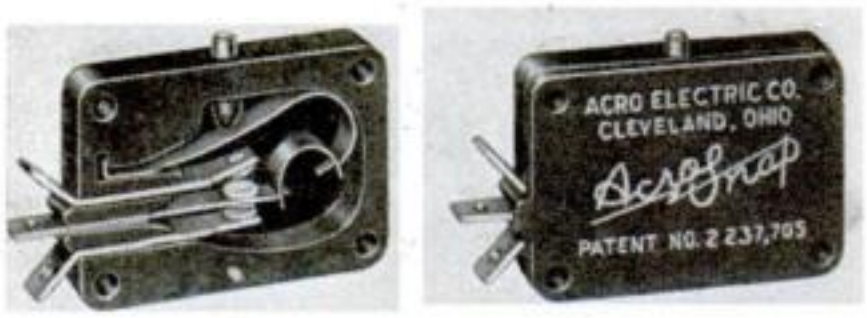
The contour image can be calibrated very easily by projecting the shadow of a tap the specifications of which are known. Thus if one having 20 threads an inch is projected, and if the lens-to-screen distance is adjusted until the apparent distance between adjacent threads is ½", the magnification will then be 10 diameters. Be sure to have the calibrating piece in the plane that the work will occupy, and remember that any movement of the unit will alter magnification.

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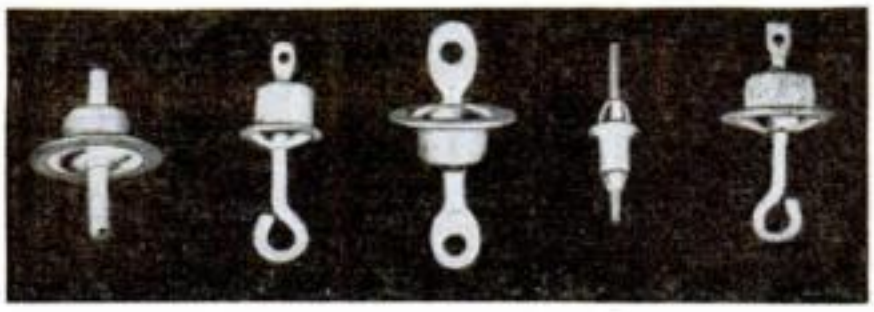
radio ideas



ILLEGAL RADIO STATIONS are smelled out by the radio "snifter" shown at the right. It is employed by the Radio Intelligence Division of the Federal Communications Commission, and will lead an investigator to the very room in which a clandestine transmitter is being operated. It works on the principle of a portable radio—the closer it is brought to the transmitter, the more intense becomes its signal. The RID has uncovered some 400 illegal and subversive stations, using first a monitor and recorder, then a powerful direction finder, and finally the snifter to locate the exact spot.



SNAP-ACTION SWITCHES operated by a beryllium-copper rolling spring and a stainless-steel actuating pin are available in miniature size. They are completely built-in and are enclosed in a 17/64" by 13/16" by 1 3/16" bakelite case. All parts are noncorrosive, the blades like the spring being of copper and the contacts of silver. The switches, rated at 15 amp., 115 volts A.C., are furnished in single-pole, normally open or normally closed, and double-throw types.

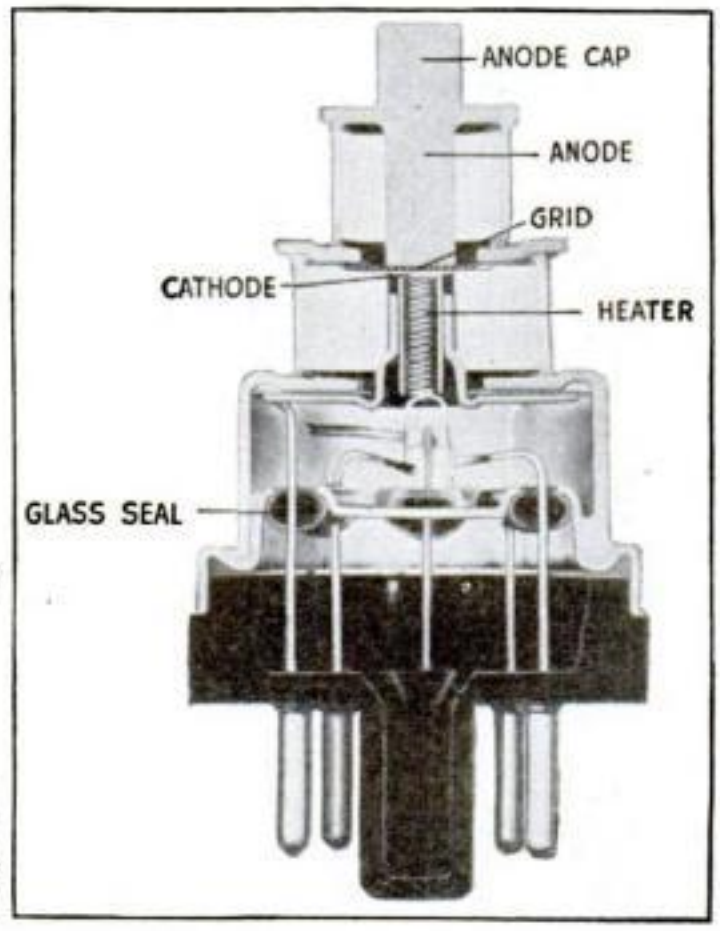


COMPLETELY SEALED LEADS for use in transformers, condensers, coils, filters, and the like can be obtained in any size or shape to meet particular requirements. They are made by Electrical Industries, Inc., of Newark, N. J., of Pyrex glass and Kovar electrodes with metal collars.

LIGHTHOUSE-TYPE MEGATRON TUBES made by General Electric for the military services, are expected to lead to rapid postwar expansion of FM and television relay systems in the high-frequency ranges. The conventional arrangement of grid, anode, and cathode is replaced by parallel planes or layers of glass and metal fused into strong, rigid units capable of withstanding severe jolts. This design permits compact structure, provides high-frequency and high-power output, and gives low plate-to-cathode capacitance.

Parallel-plane construction is particularly important in the high-frequency portions of the radio spectrum for which tubes can now be made with sufficient power. It will also make available many high and ultra-high frequencies.





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ADAPTING AUTO RADIOS TO HOME USE

Servicing Your Radio

WITH a few basic changes an automobile receiver can be adapted for use in the home on standard house current. Some of the parts do not work on 115-volt A.C., but substitution of parts that will results in conversion of the entire set.

First, get a new speaker—a permanent-magnet type. Most automobile speakers use a 6-volt D.C. field, and you will need one that uses no current for the field. Merely connect the voice coil to the leads that were connected to the voice coil of the original speaker. In some cases, a plug arrangement may permit returning the set to the car.

The power supply must also be changed. There are two types commonly used in auto receivers. For that employing a tube rectifier (Fig. 1), obtain a 110-volt power transformer that will deliver 150 milliamp. at 250 to 350 volts and 6.3 volts for tube heaters. Use the same rectifier, hooking the high-voltage leads to the two plates as shown. These are the same connections used for the old transformer.

After this, remove the input-line and ignition filter and add an on-off switch to break the 115-volt A.C. circuit. Run the filaments of the tubes from the 6.3-volt A.C. winding of the transformer, hooking the transformer lead to any convenient filament prongs in the set and grounding the other end of the transformer winding. The circuit is shown in Fig. 2.

In an automobile receiver with a power supply utilizing a synchronous-type vibrator, the high-voltage input comes from the center tap of the car transformer. Use a new power transformer with a center tap to connect to the filament of an 80, 5Y3, 5Y4, or similar-type rectifier tube, and use the 5-volt winding to drive the rectifier filaments. This, of course, requires the addition of a tube and socket as well as the power transformer.

A long antenna is not necessary since automobile receivers are made to operate on very short whip antennas. A short piece of wire—about 20'—will serve very well. The speaker may be mounted on the panel of a cabinet or in any way suited to its use. Insert the shut-off switch, which should be a 110-volt type, in one lead to the transformer primary.—G. O. SMITH.



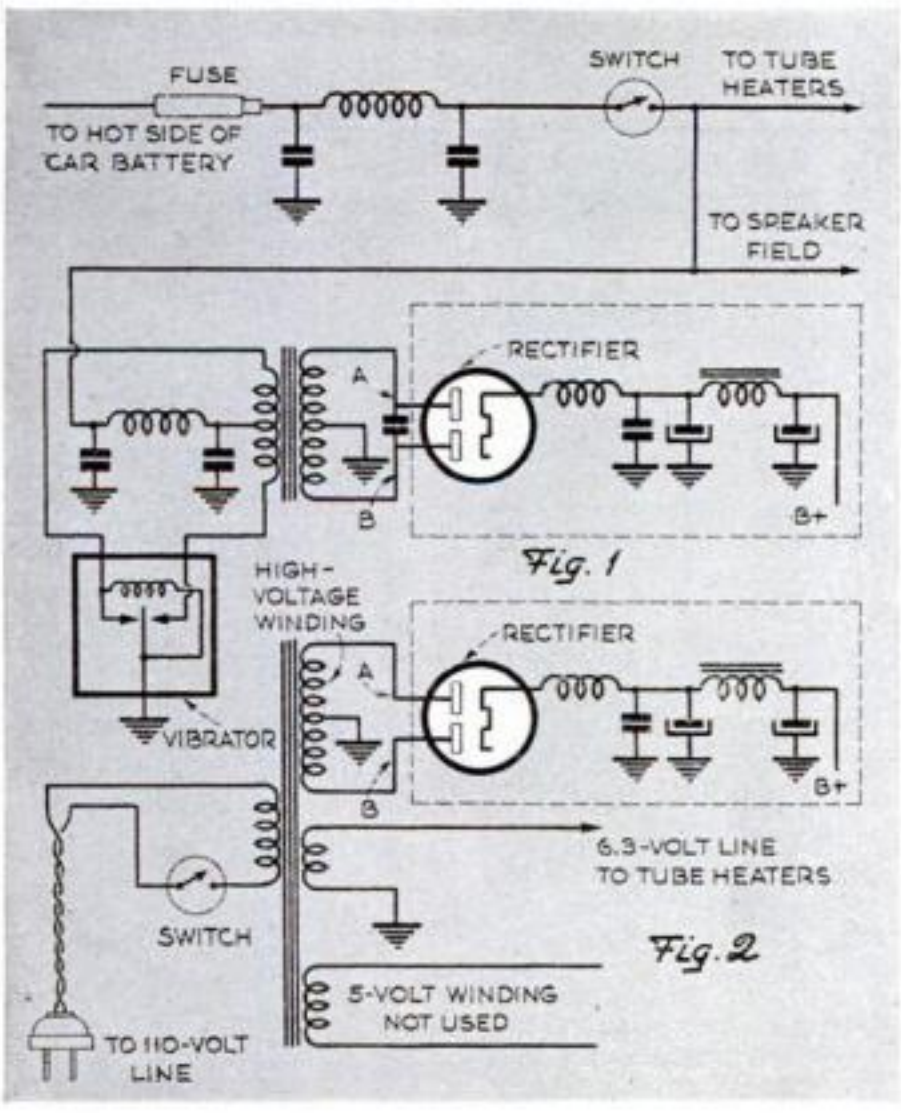


Fig. 1

Fig. 2

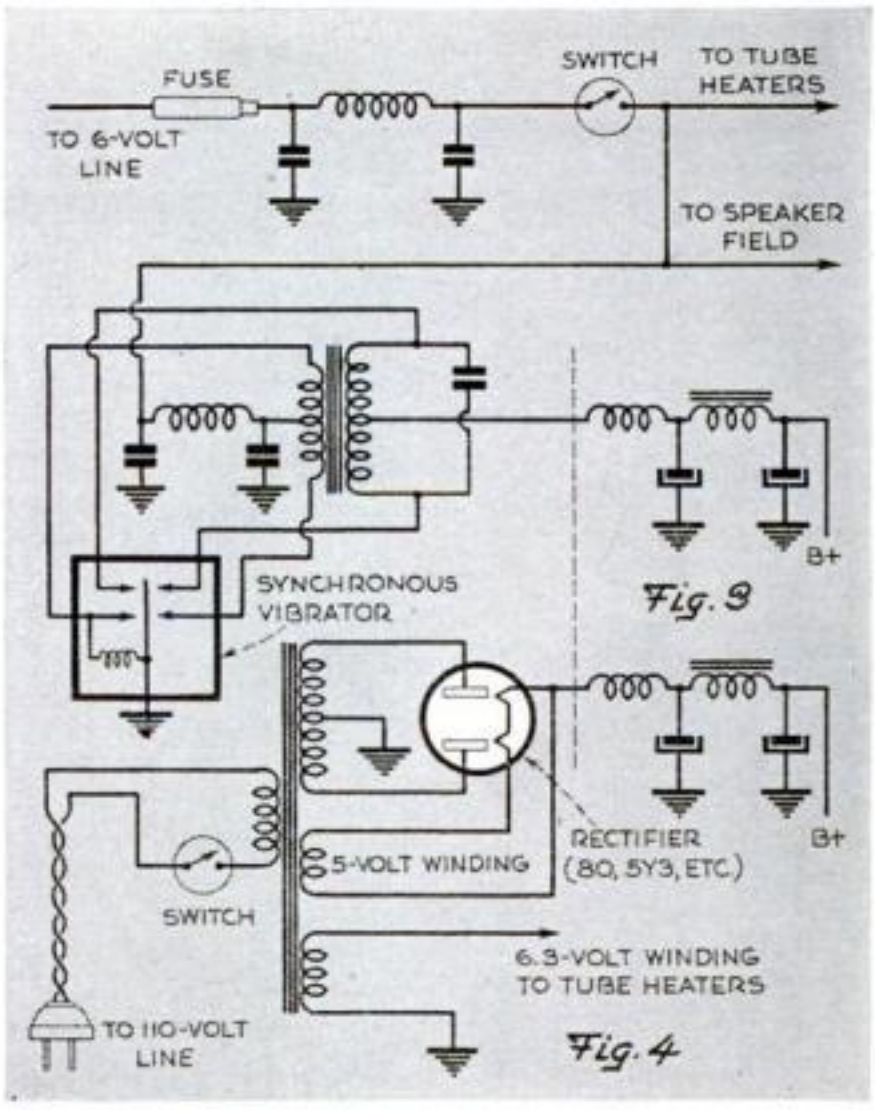
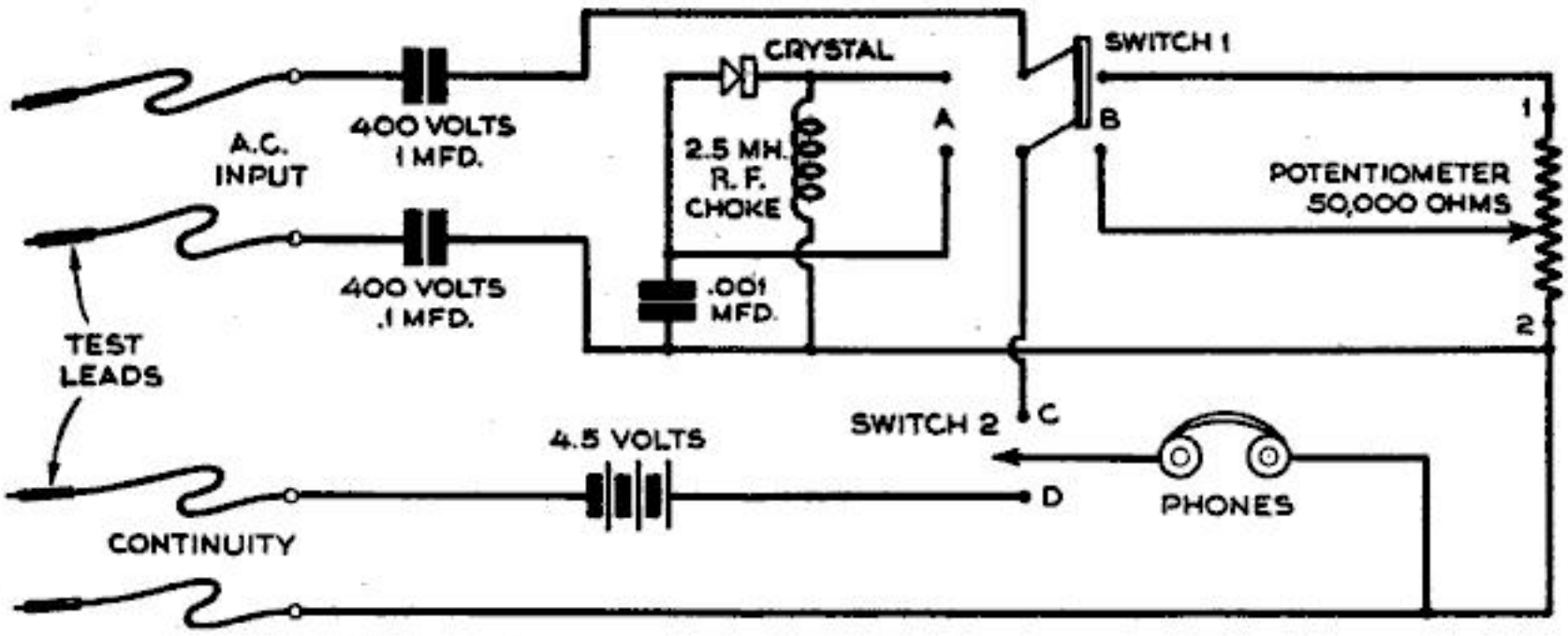


Fig. 3

Fig. 4

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Radio Circuit Tester Uses Headphones and Standard Parts

THIS simple test circuit will prove useful to the student of electronics or the experimenter, and will often track down trouble that can't be located by guesswork.

To check audio signals, use the A.C. input leads with switch 1 at *B* and switch 2 at *C*. For example, if distortion is to be localized, put the leads first across the plate and cathode of an output tube, then across the grid and cathode. If the signal is clear at the grid but not at the plate, the distortion is in that output stage or tube.

For radio-frequency tests, set switch 1 at *A* and switch 2 at *C*. Place the prods on the plate of the tube and the positive side of the plate supply. The signal should be heard, rectified by the crystal detector. Shift the lead from the plate to the grid. If the signal is not much weaker, the gain of the stage is low and some defect exists.

For continuity tests, disregard switch 1 and set switch 2 at *D*. To test a fixed condenser, touch the prods to its terminals. A click should be heard. Remove the prods, wait a few seconds, and again apply them. The click should be much weaker, showing that the condenser has held the charge.

Coils, resistors, and tube filaments may be tested on the same circuit. No click means an open circuit. Tuning condensers can be tested by first disconnecting the leads to prevent shorting through other parts. No click should be heard when the rotor is turned. Never use the continuity leads on a receiver unless the line cord or batteries are disconnected.—WILLARD MOODY.

PERMISSIBLE VOLTAGE DROP [ELECTRICAL]

WHAT must be the rated capacity of a 10,000-ohm resistor across which the voltage drop is to be 125 volts? The table below shows instantly that the permissible voltage drop across a 1-watt, 10,000-ohm resistor is 100 volts, which is too small. The drop across a 2-watt resistor may safely be 140 volts. A 2-watt unit is therefore required. As another example, if a 500-ohm resistor rated at 3 watts is at hand, it may safely be used to create a potential drop of 38 volts or less.

Ohms	1-watt size	2-watt size	3-watt size	10-watt size
100	10	14	17	30
200	14	20	24	45
300	17	24	30	55
500	22	31	38	70
700	26	38	45	85
1,000	30	45	55	100
2,000	45	65	80	140
5,000	70	100	125	225
7,000	85	120	145	265
8,000	90	125	155	280
10,000	100	140	170	310
20,000	140	200	245	445
30,000	170	245	300	550
40,000	200	280	345	over 550 volts
50,000	225	310	385	
70,000	265	375	460	
100,000	310	450	550	
200,000	450	500	over 550	
300,000	over 500	over 500		
400,000				
500,000				

POPULAR SCIENCE MONTHLY SHOP DATA

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A RELIABLE REVERSING SWITCH for a motor can be made of the distributor cap from a six-cylinder car and some odd scraps.

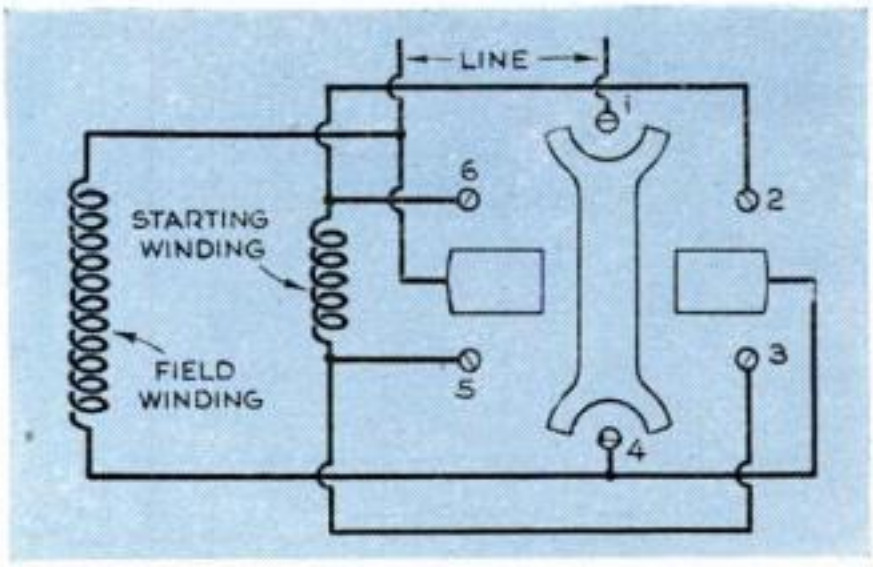
Measure the depth of the notches on the inner wipe contacts or studs, and from fiber or composition board about 1/16" less in thickness cut a disk to fit freely within all six notches, leaving the stud ends exposed.

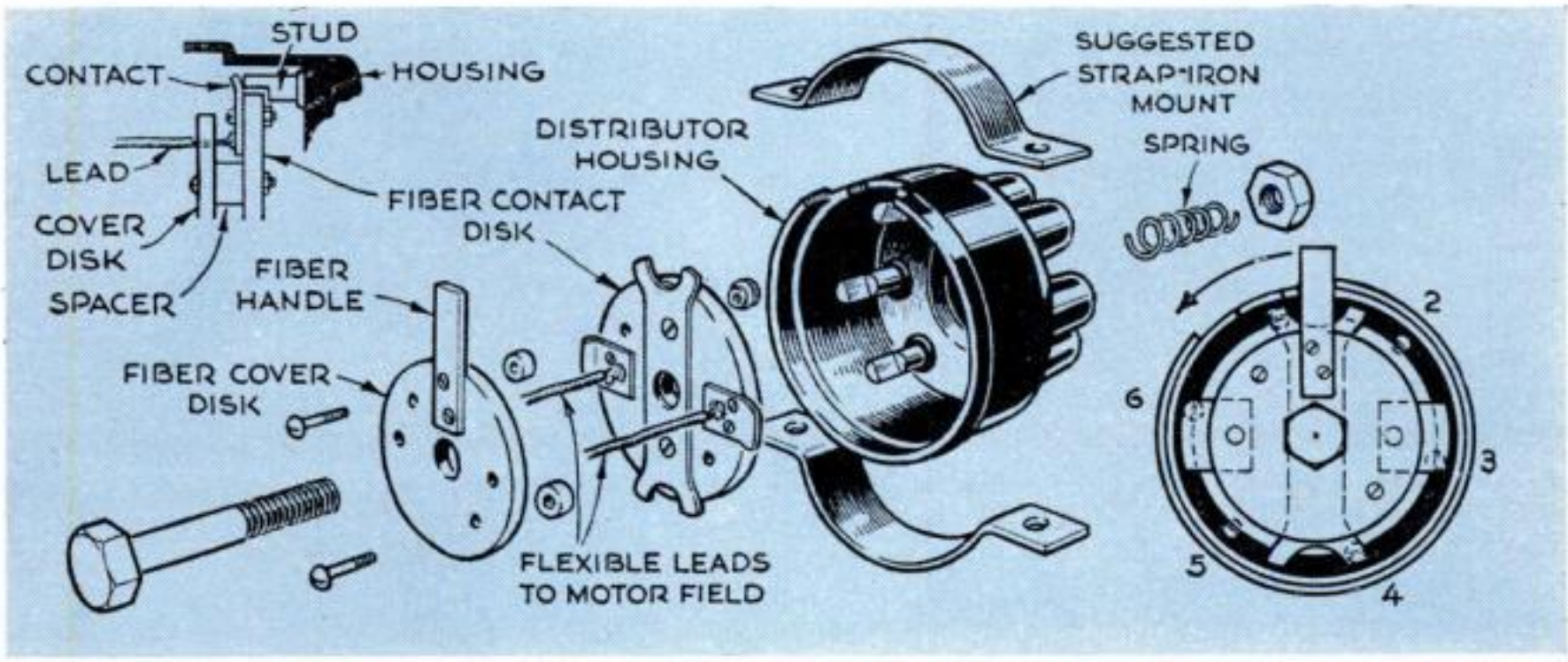
Make the two small contact plates somewhat narrower than the distance between two adjacent studs, so that a plate can never touch two studs at once.

The long spring contact can be made of phosophor bronze or of clock spring with copper contact surfaces soldered on. Shape it so that one prong at each end will rest upon the stud when the short contacts are at either end of their travel, as shown. Midway of this, the spring prongs should make no contact. Make the hole for the assembly bolt big enough so that it will pass through without making electrical contact.

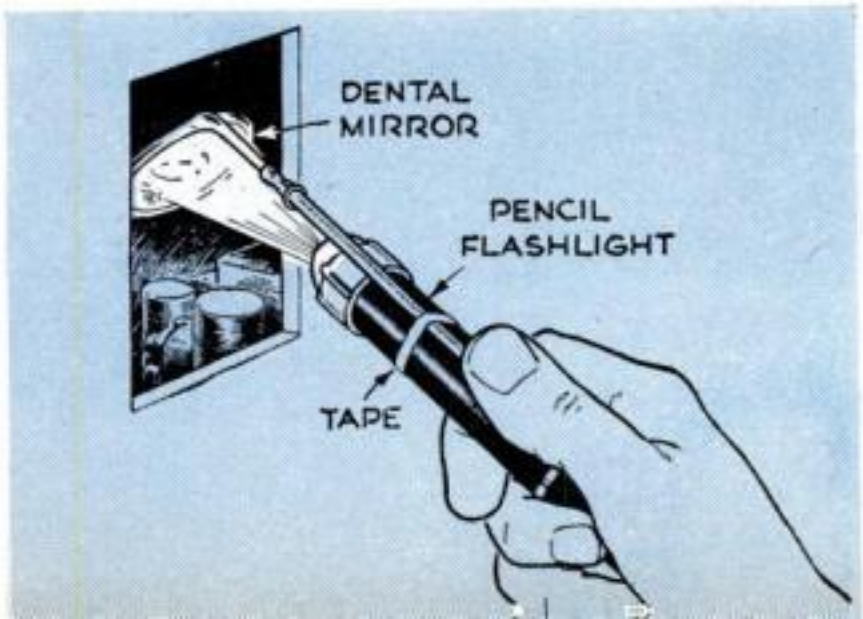
Cut a fiber cover disk and attach a short handle; then solder flexible leads to the small contacts, bring them through holes in the cover disk, and bolt the disks together with spacing washers between to allow play for the spring contact. File a shallow notch in the rim of the cap just long enough to allow the proper amount of travel for the handle. At its midpoint file a second shallow notch to provide an "off" position.

Assemble the switch with a small cap screw, spring, and nut, filing a bevel on the contacts if necessary to make them ride up on the studs readily.—EDWARD MOONEY.

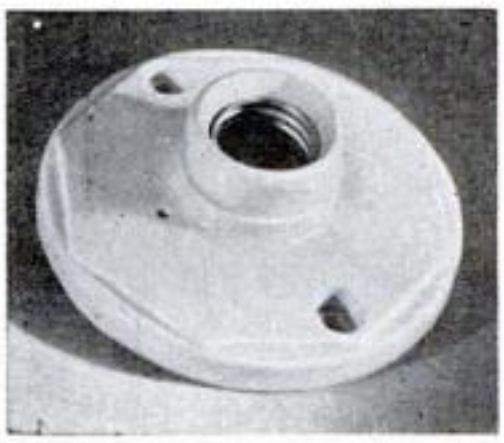




INSPECTING CONNECTIONS, contact points, or small, inaccessible parts may be made easier with a dental mirror taped to the barrel of a vestpocket flashlight. Bend the handle so that the beam hits the mirror squarely and is reflected to illuminate the area under inspection.—JOHN KRILL.

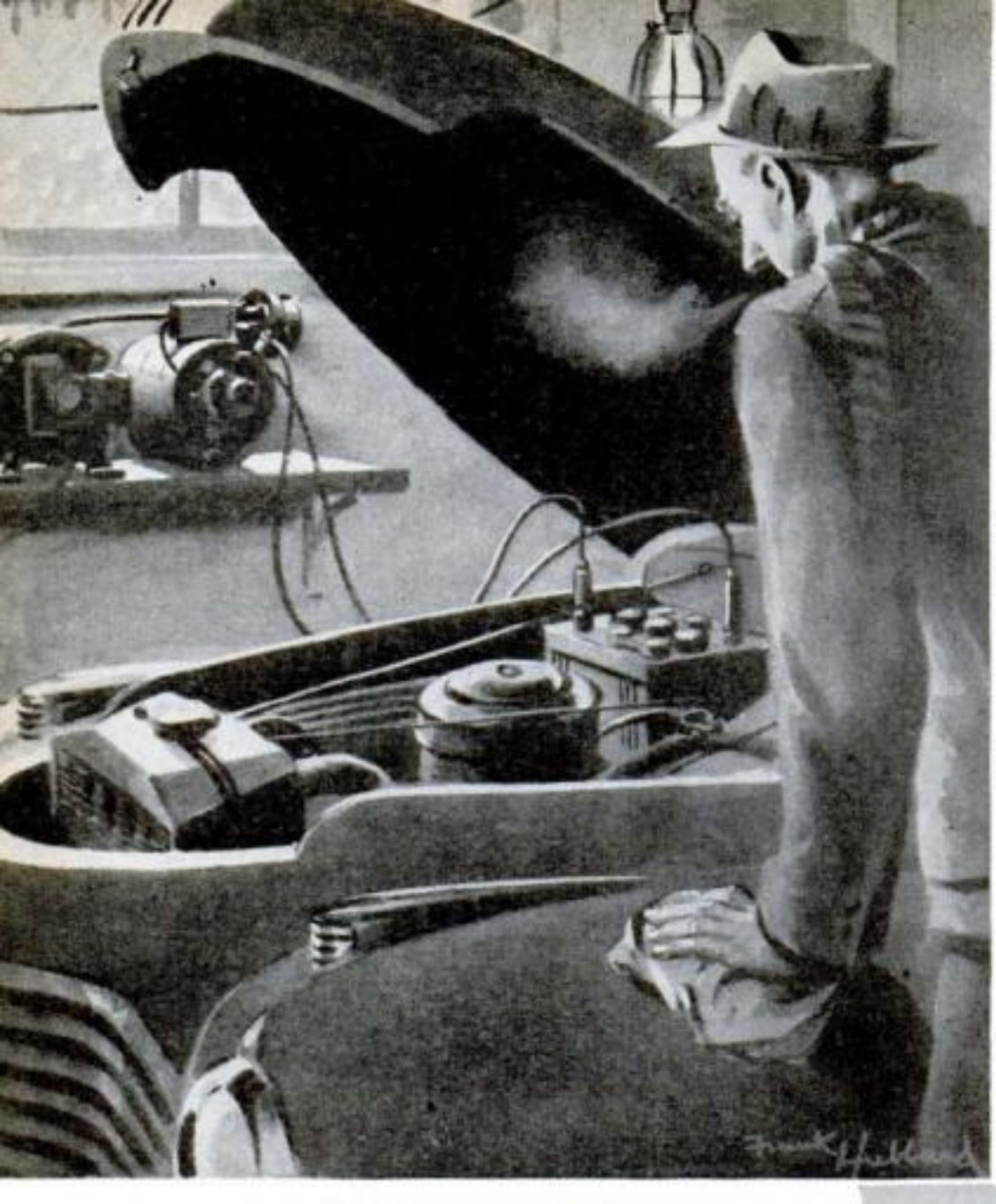


CANDLESTICKS are sometimes needed in a hurry when an emergency occurs. Common plumber's candles can be set into standard porcelain fixtures such as shown below. So held, they will not drip on the surface they rest upon.





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MOTOR

This Homemade Charger

By HAROLD P. STRAND

ONE of the simplest and most dependable ways of charging storage batteries is with a motor-generator set. Readily assembled from a shop motor and an old auto generator, the unit affords an easy means of putting new pep into car batteries to meet heavy wintertime drain. It will also serve as a convenient D.C. supply for home electroplating, running a two-rail model railroad, charging electric-boat batteries, and the like.

The complete unit, shown in Fig. 1, consists of a ¼-h.p. split-phase motor, a generator picked up in a junkyard for $3, and a one-to-one V-belt drive. It will deliver a continuous 8-amp. charge without overloading the motor; and the rate could be increased to about 13 or 14 amp. by the use of a ⅓-h.p. motor. The generator is one of the older type employing third-brush regulation which was widely used on several makes of popular cars. In shopping for a suitable generator, don't buy a heavy-duty type unless you are prepared to supply the power to drive it efficiently. Pick one that appears to have good bearings and a commutator that is free of grooves and deep pits. You'll probably have to take a chance on the condition of the windings, since there's little chance to test them in most junkyards. If possible, get one with a cutout in good condition.

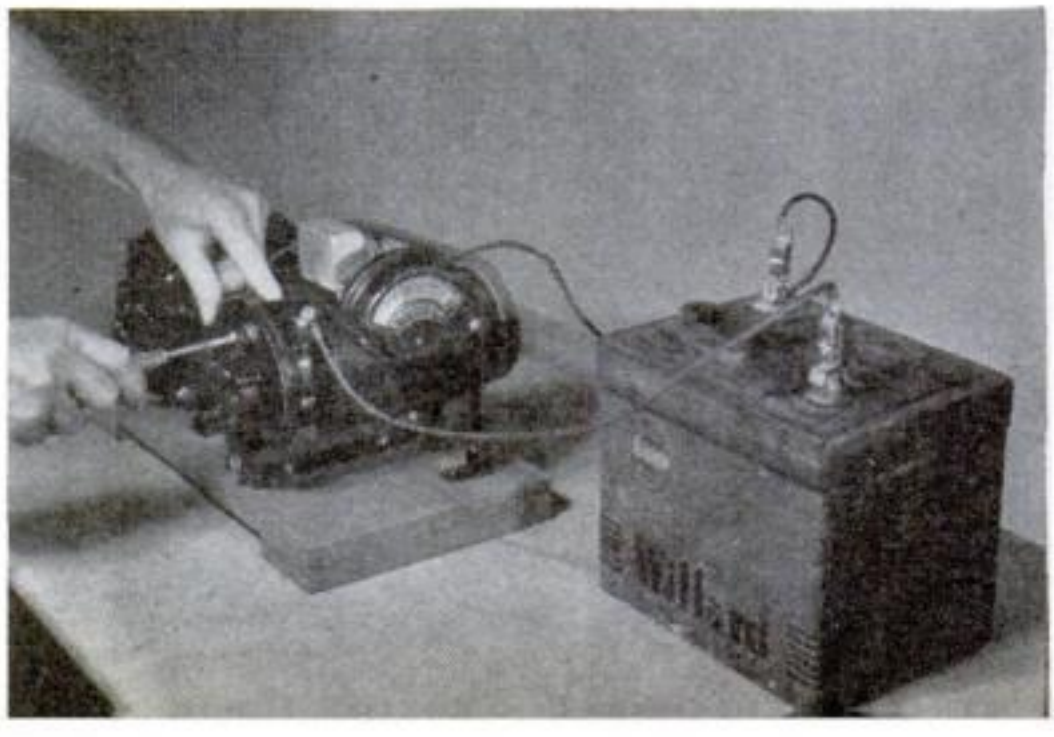
After cleaning up the generator case, inspecting the brushes, and lightly sanding the commutator, set up the generator temporarily for testing, and drive it at 1,700 or 1,800 r.p.m. If it is possible to determine direction of rotation from evidences of the way the generator was mounted in a car, it should of course be driven in that direction; if you cannot tell, try both directions to see which way it will build up current.

Sometimes it may be necessary to "flash" the generator to start the building-up process, that is, to short-circuit the generator for an instant while it is running. Connect a jumper



1 The complete unit, consisting of a shop motor, an old generator, a cutout, and an ammeter, is pictured here in finished form, charging an automobile storage battery

4 Adjustment of the charging rate in a three-brush generator is made by loosening a screw and then pushing the third brush with a finger. Retighten screw to lock



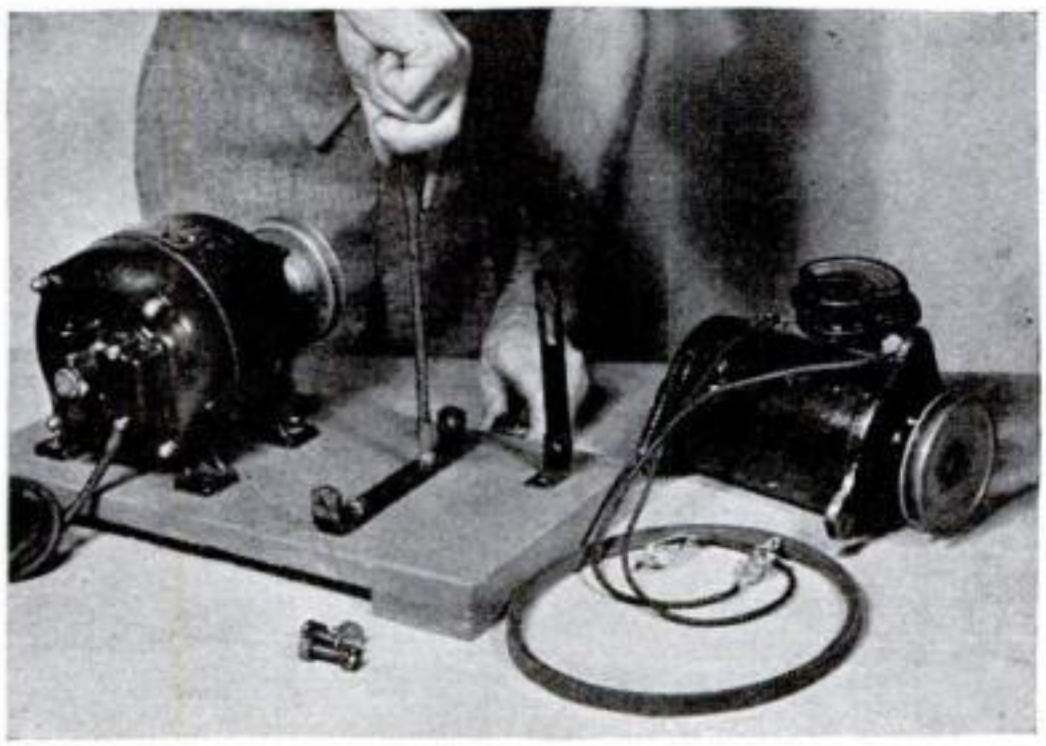
GENERATOR SET

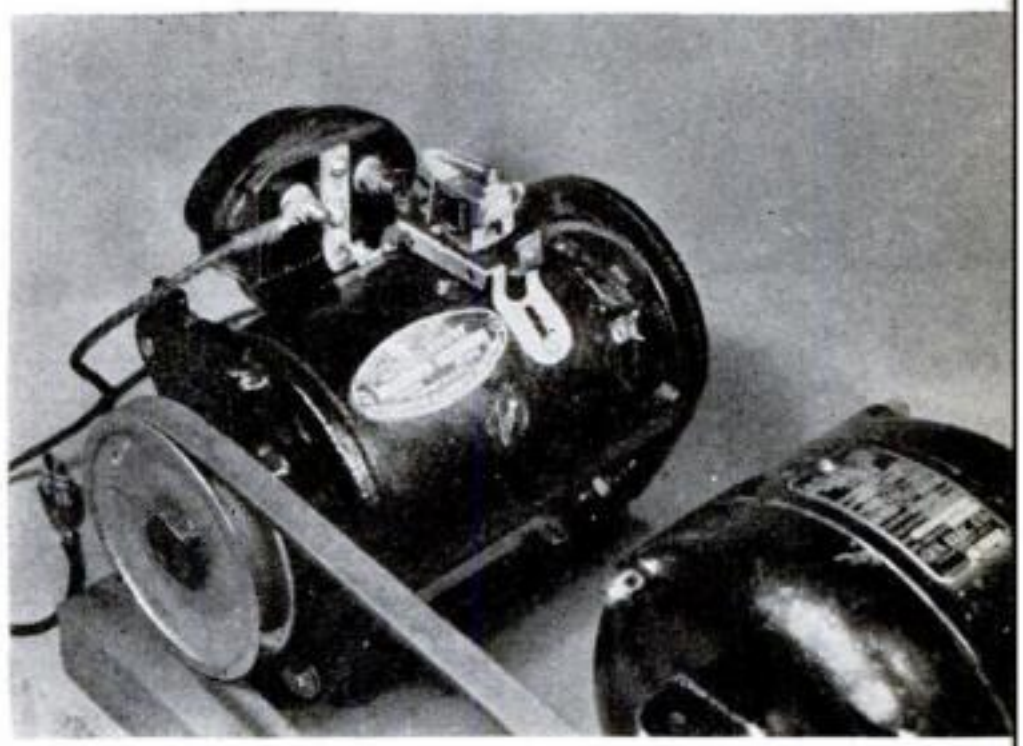
Will Be Invaluable in Boosting Winter-Weakened Auto Batteries

to the frame and touch it briefly to the input terminal on the cutout. If this doesn't work for either direction of rotation, try flashing the fields from an outside source. To do this, lift the insulated brush (the one that supplies output) and connect a storage battery with one lead to the frame and the other to the third or adjustable brush. With the generator idle, make several short applications of the current; then replace the lifted brush and try the generator once more. If it still doesn't generate, the only thing to do is to take it apart and test each component separately.

The armature may be tested for shorts or open circuits in a growler; if you don't have one, the job can be done in an auto service station. The field should also be inspected for open circuits and grounds by means of a series test lamp, as in Fig. 5, and the brush-holder assembly may be similarly tested, as in Fig. 6. Make sure that the ground connection from field to frame is clean and tight, that the insulation of the leads is in good shape, and that the bearings are not so worn as to permit the armature to touch the field poles. While you have the generator apart, it's a good idea to undercut the commutator and to turn it down in a lathe if the surface isn't smooth.

As soon as you have made sure that the generator builds up, mount it permanently with its motor on a wooden base. The original mounting bracket can be utilized by attaching it to the base with 5/16" machine bolts. A slotted arm, also secured to the base, will allow you to adjust belt tension. Details of the mounting method are shown





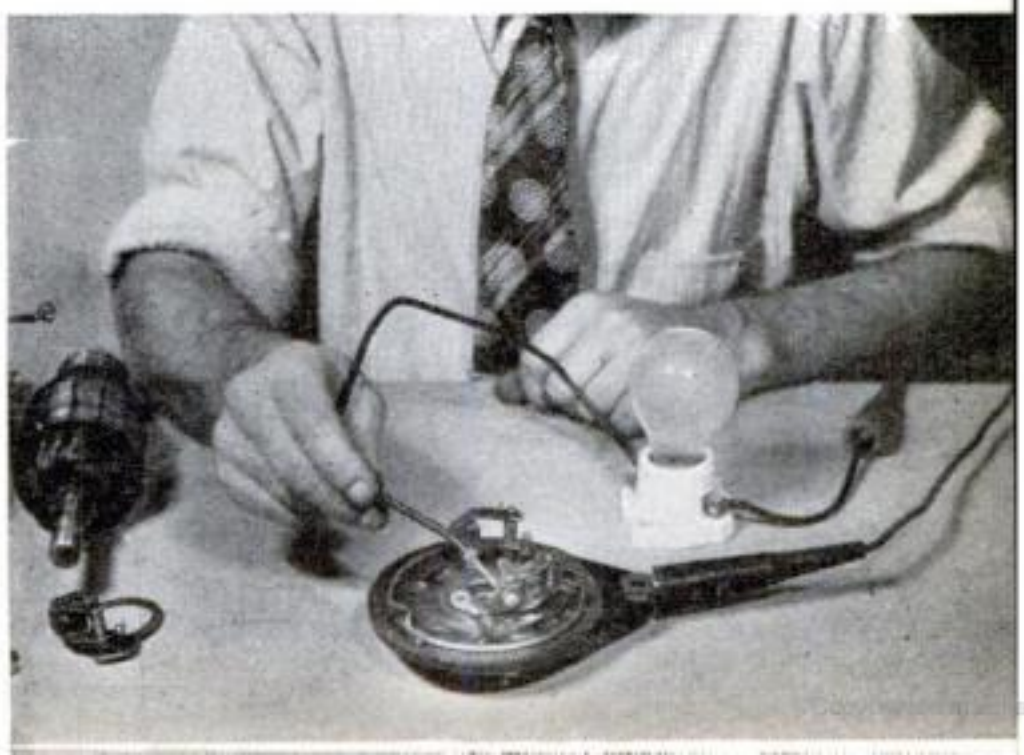
2 Here the mounting bracket originally used on the car is being affixed for holding the generator. A slotted upright helps in adjusting belt tension

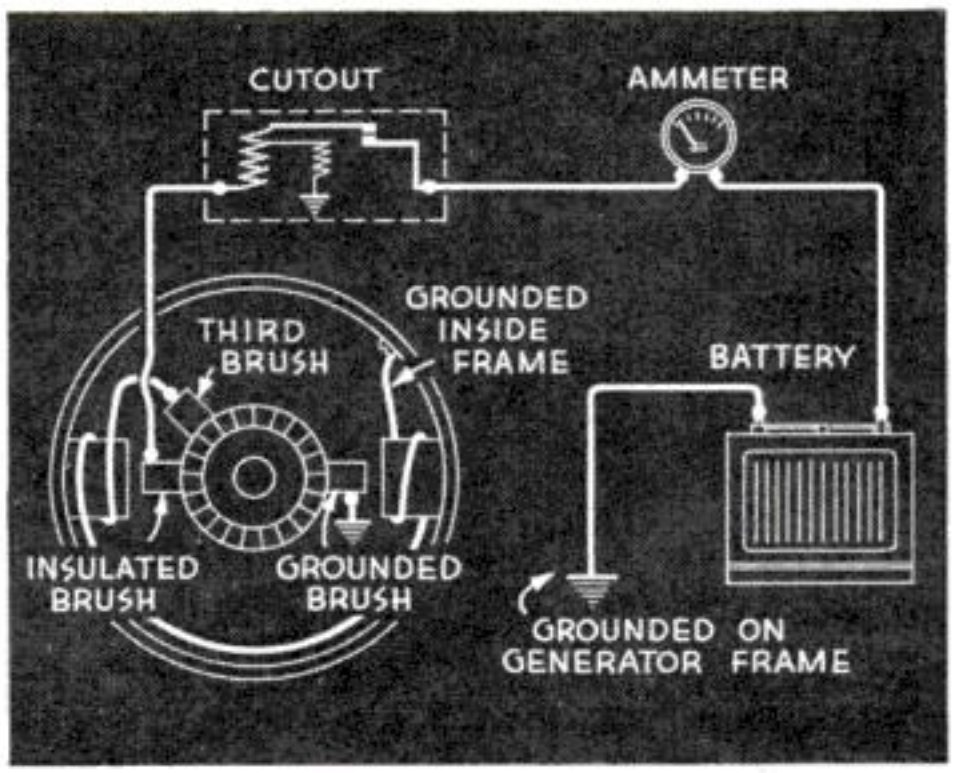
3 A standard generator cutout is needed if the unit is used to charge batteries, because it gives protection if the motor should be stopped

5 If the generator fails to build up current, the field can be checked for a possible ground or a broken circuit by the use of a series test hookup

6 A series test lamp will also come in handy in making certain that one brush is grounded and the other two aren't. Replace them if badly worn







Three-brush generators were once common on light cars

in Fig. 2. About 1,750 r.p.m. is a good generator speed; if you use a motor of higher or lower speed, select pulley sizes that will produce this.

The circuit diagram of a three-brush generator is illustrated above. Note that one brush and one end of the field are grounded, that the other end of the field connects to the third brush, and that the insulated brush supplies the output in conjunction with the ground. If you plan to use the motor-generator set to charge batteries, be sure to use the cutout, since it protects the battery against accidental discharge if the power to the motor should be cut off.

In wiring the unit, run the insulated-brush lead to the cutout, where it should be attached to the terminal that is connected to one end of the heavy winding in the cutout. The other cutout terminal is connected by a short wire to one side of a small ammeter, to the other terminal of which is attached a wire terminating in an alligator clip. The other main lead runs from a ground on the generator frame, made by drilling and tapping for a 10-32 screw, and ending in another clip. Take pains to make all connections as clean and tight as possible, and use fairly heavy wire.

Before clipping the leads to a battery for a charge, determine the polarity of the charging line. This may be done with a D.C. voltmeter, or by placing the clips in a glass of salt water with the generator running. Bubbles will collect around the negative clip, which is the one attached to the negative battery terminal. Mark each clip with a plus or minus sign for future reference. Incidentally, do not ever run the generator for more than a few moments without attaching a load across it, because the voltage may build up to a value that will damage the field coils.

The charging rate may be adjusted by moving the third brush. Fig. 4 shows how, by loosening a clamping screw, the brush can be moved with the fingers. Pushing it in the direction of rotation increases the charging rate. To determine how much the rate may be advanced without overloading the motor, connect an A.C. ammeter in series with one motor lead. Then, with the generator charging a battery, advance the third brush until the motor ammeter reaches the figure stamped on the motor plate as the full-load current.

OHM'S LAW

[*ELECTRICAL*]

IN ANY electrical circuit, a definite relationship exists between the resistance, the impressed voltage, and the current that is flowing. An ohm, the common unit of resistance, may be defined as the resistance through which 1 amp. will flow when a potential of 1 volt is applied. As set forth in Ohm's Law,

$$I = E \div R$$

where I is current in amperes, E potential in volts, and R resistance in ohms. Thus amperes = volts ÷ ohms.

Where resistance is the unknown quantity, this formula becomes $R = E \div I$ (ohms = volts ÷ amperes); and where voltage is the unknown factor, $E = R \times I$ (volts = ohms × amperes).

A simple way to memorize Ohm's Law is to remember the expression

$$E \div (R \times I)$$

Remove from this the unknown to be determined and place it before the remaining symbols with an equals sign between, and you will have the formula applicable to the problem. Thus, to find E, place it outside and obtain $E = R \times I$. To find R, remove it and use the formula remaining: $R = E \div I$.

EXAMPLE: A 3-volt bulb is rated at .8 amp. What is its resistance? Applying the formula $R = E \div I$, we divide 3 by .8 and obtain the answer 3.75 ohms.

EXAMPLE: What current will be drawn by a 10-ohm resistance connected across a 6-volt storage battery? Substituting known values in the formula $I = E \div R$, and so dividing 6 by 10, we find the answer to be .6 amp.

EXAMPLE: An ammeter shows that 5 amp. flows through a 22-ohm resistance. What is the applied voltage? Since $E = R \times I$, we multiply 22 by 5 and find the answer to be 110 volts.

POPULAR SCIENCE MONTHLY SHOP DATA

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The Chemistry of Solutions



Ammonia gas dissolves in a little water introduced in the flask, creating a partial vacuum that starts this fountain

By KENNETH M. SWEZEY

WHENEVER you stir sugar into a glass of lemonade, you perform a feat of magic as marvelous as any on the stage. With a twist of the spoon, you make a solid vanish so completely that no microscope is powerful enough to detect it. Your taste will tell you, though, that the sugar is still present and in equal amount in every drop of the liquid. Let the water evaporate, and, lo! mixed with solids from the lemon juice, you will find your sugar back again.

All solutions involve this same magic. The dissolved substance, or *solute*, disappears completely and uniformly in the dissolving substance, or *solvent*. In a true solution, the solute can never be separated; yet remove the solvent by evaporation or other means, and the solute reappears.

Exactly what happens when a substance goes into solution, nobody knows. It is evident, however, that the solute breaks down into individual or small groups of molecules that dart about distributing themselves uniformly thoughout the solvent.

This motion can be demonstrated by dropping a few grains of a water-soluble dye into a tall glass or cylinder of water. At first the dye falls straight down, pulled by gravity; then the grains swirl with the water currents and finally go into solution, spreading uniformly throughout the water.

Heat is required to free molecules so they can move. This heat is extracted from the solvent and it is cooled. Some substances also react chemically with the solvent and produce heat. If the cooling and heating balance, the temperature won't change.

These reactions may be demonstrated with sodium hydroxide, or ordinary lye, and ammonium nitrate. Stir the powders into separate glasses of water at room temperature and test with a thermometer. The lye solution will be near the boiling point, while the other will be at freezing or below.

Temperature also determines the amount of a given substance that will dissolve in a particular solvent. Except for a few chemical compounds such as some calcium salts and certain organic acids, solubility increases with a rise in temperature—not much in some cases, enormously in others. You can dissolve about 36 grams common salt or 31 grams saltpeter in 100 ml. water at room temperature; at the boiling point, you can dissolve only three more grams of salt but 215 more of saltpeter.

Most solutions that are saturated at high temperature must be kept at that temperature or the solute will crystallize out. For

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a fascinating demonstration of this, dissolve as much lead iodide as you can in a test tube of boiling water, stirring for several minutes. Then support the tube upright and let the solution cool. Tiny golden crystals will begin to form all through the solution, growing before your eyes and finally falling slowly in a beautiful golden shower.

A *saturated* solution is generally defined as one containing as much dissolved solute as it can hold. This is not exactly true, for with care, and with certain chemicals, you can make *supersaturated* solutions—unstable solutions that will part readily with their excess solute.

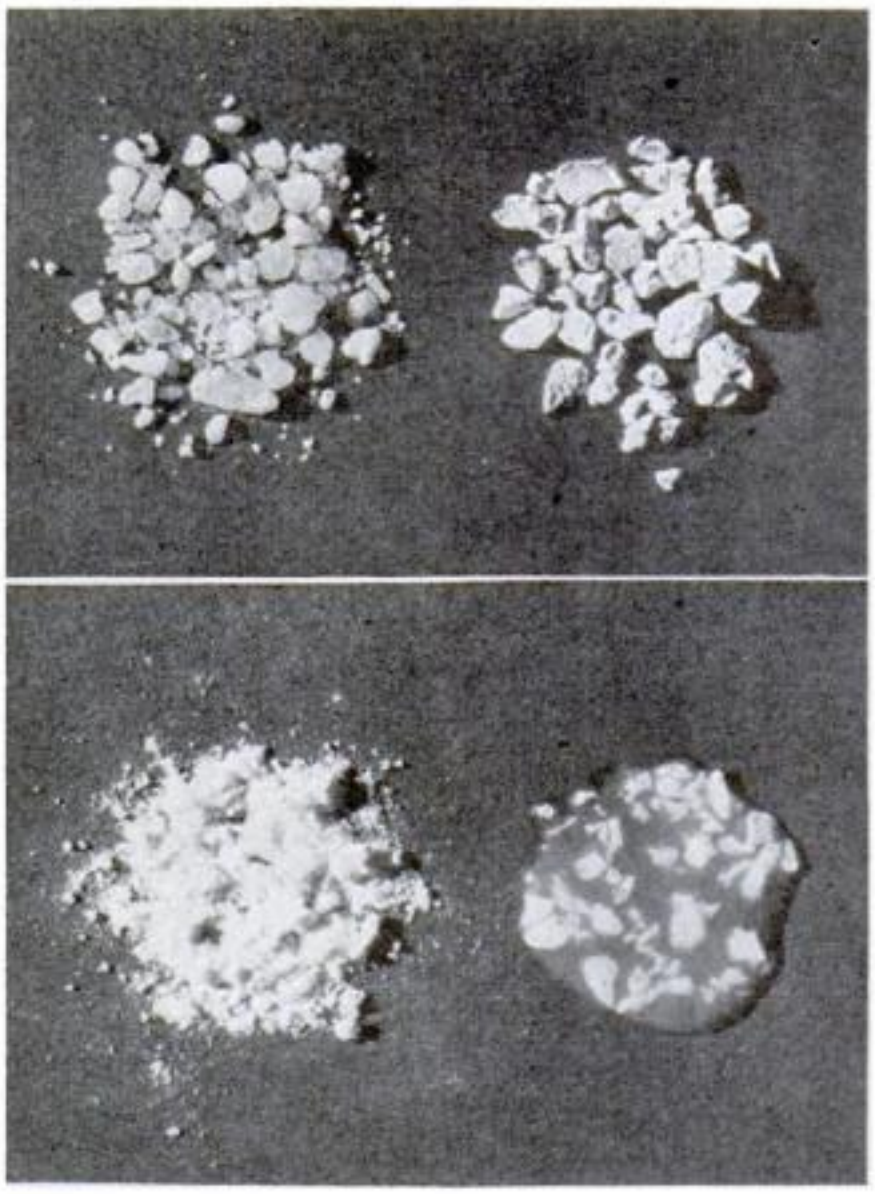
With ordinary photographers' hypo (sodium thiosulphate), you can demonstrate this. Half fill a small beaker with hypo crystals and place the beaker over a small flame. The crystals will soon form a liquid as they dissolve in their own water of crystallization. If the beaker is clean and if there are no foreign particles or undissolved crystals in the solution, the product may be cooled without having crystals form. Add a single crystal of hypo, however, or even scratch the bottom of the cooled beaker with a stirring rod, and crystallization begins, causing the whole solution to solidify.

A more accurate definition of a saturated solution therefore is that it is a solution that will not gain or lose in concentration if a little undissolved solute is added. In your practical laboratory work, you may consider a solution saturated if, after a reasonable amount of stirring, some of the solute settles to the bottom.

Many crystalline compounds already contain, like the hypo, water as a definite part of their composition. This water exerts an outward pressure against the pressure of the water vapor in the air. If the crystal-water pressure is greater than the atmospheric-vapor pressure, the crystal will give up its water and slowly crumble into a dry powder. This is called *efflorescence*. As an example, leave a few crystals of washing soda in the air of a warm room, and they will soon fall into a white powder. Washing soda that has thus lost water, however, has by no means deteriorated. It has really gained in strength.

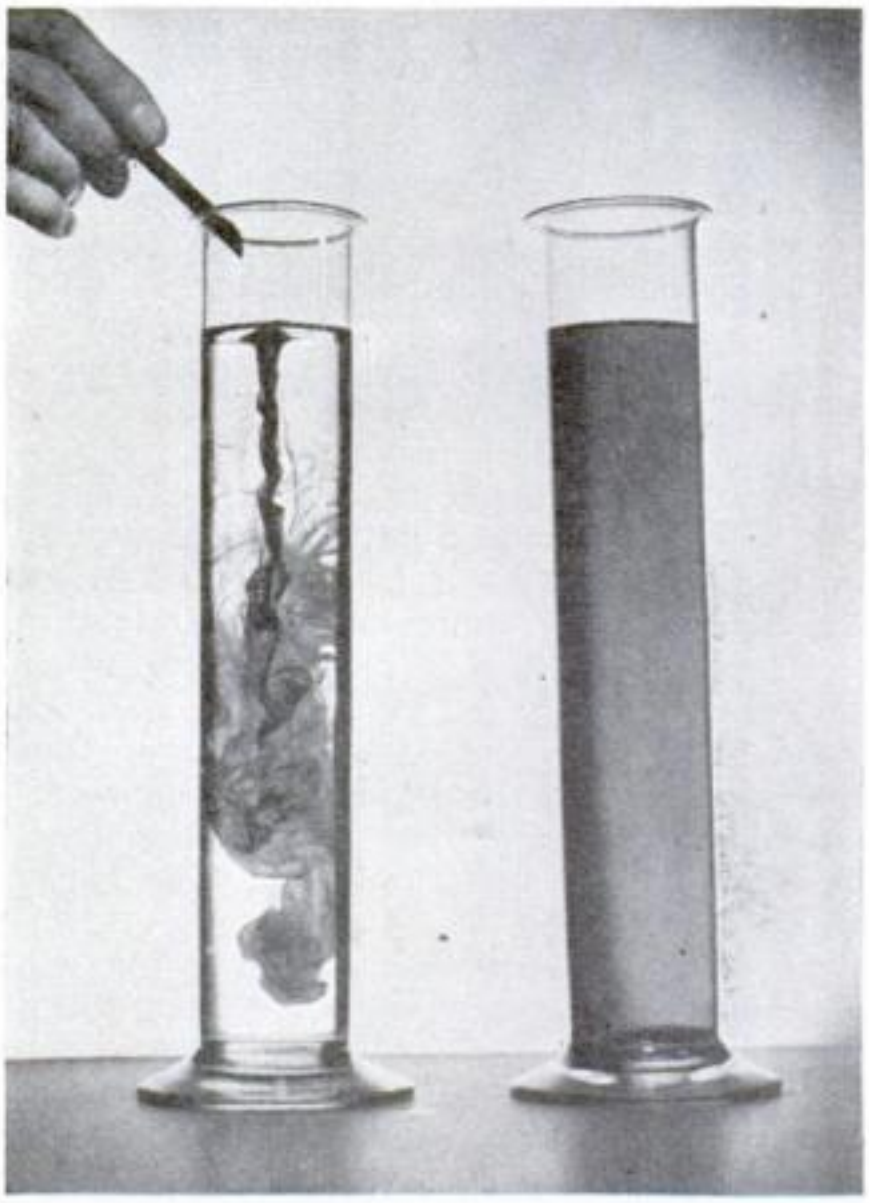
Some other chemical compounds, originally dry, readily absorb water from the air, and some even finally dissolve in their absorbed water. These chemicals are called *deliquescent*. Calcium chloride, used to dry out cellars and to keep roads and tennis courts moist by absorbing moisture from the atmosphere, is an example. Left beside the washing-soda sample that dries out, it soon gathers a puddle of water.

Because it dissolves so many things, water is called a universal solvent. When a sub-

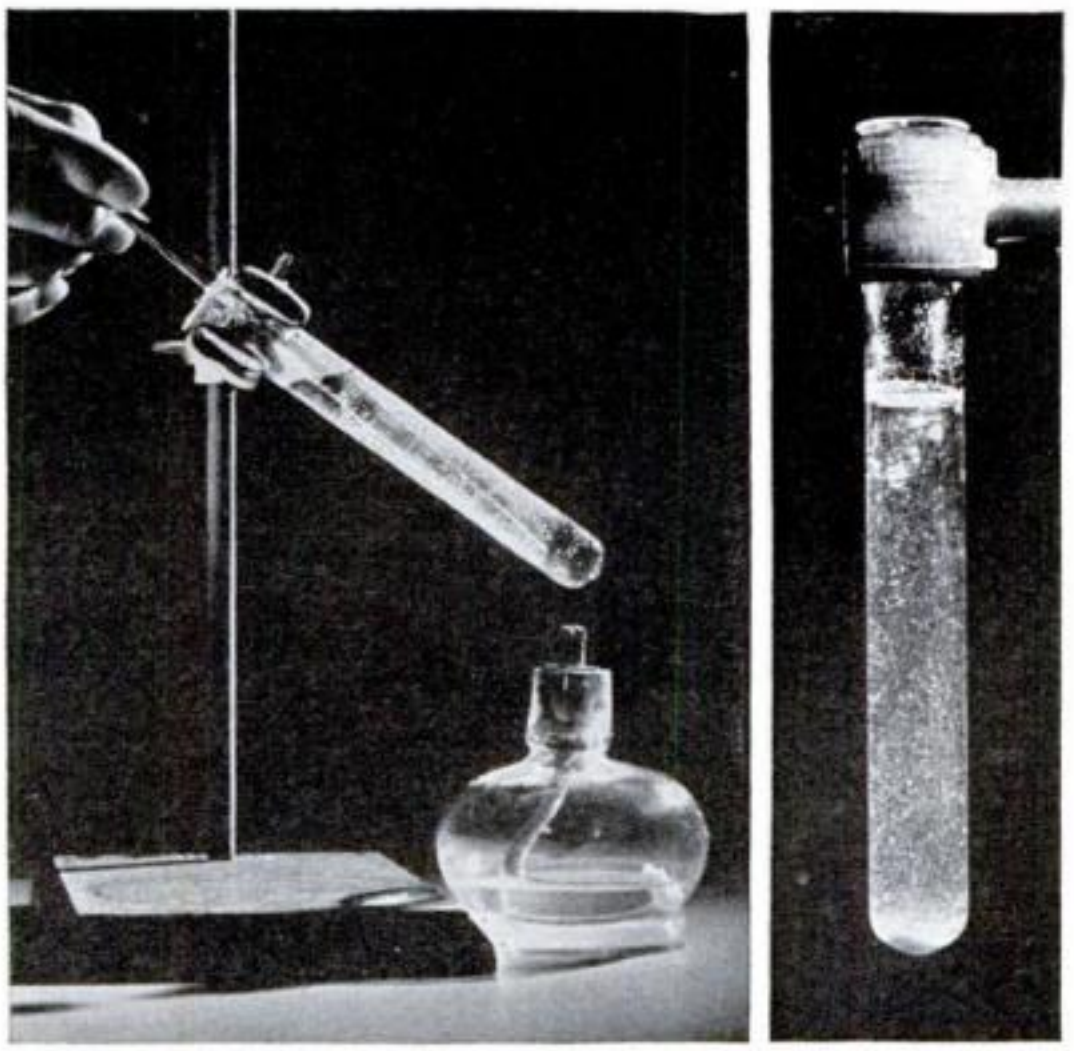


Crystals of washing soda dry out to powder in the air, as shown at the left, while calcium chloride absorbs so much water (right) it actually swims

Dropped into water, dye is pulled down by gravity, and then molecular motion sets in, swirling it in the liquid until it becomes uniformly distributed



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To obtain a saturated solution, dissolve as much lead iodide as you can in boiling water. When the solution cools, tiny crystals fall in a glittering golden shower

stance is said to be soluble, the solvent is assumed to be water unless another is mentioned. There are dozens of other solvents. Alcohol, ether, acetone, carbon tetrachloride, and turpentine are well known.

Besides solutions of solids in a liquid, there can be solutions of liquids in liquids (alcohol in water, for example), gases in liquids (household ammonia), and even solids in solids. Solder, brass, and many other alloys are so united chemically that they are often spoken of as solid solutions.

Soda water is a solution of carbon dioxide gas in water. It bubbles as it warms up to room temperature because, unlike solutions of solids in liquids, the saturation point of gases in liquids decreases as the temperature rises.

At room temperature, 90 cc. carbon dioxide can be dissolved in 100 ml. water; but hydrogen chloride can dissolve to the amazing amount of 44,200 cc., while ammonia gas can squeeze itself into water at the rate of 70,000 cc. to 100 ml. The extreme solubility of these two gases can be used in performing the picturesque demonstration of a fountain shown on page 199.

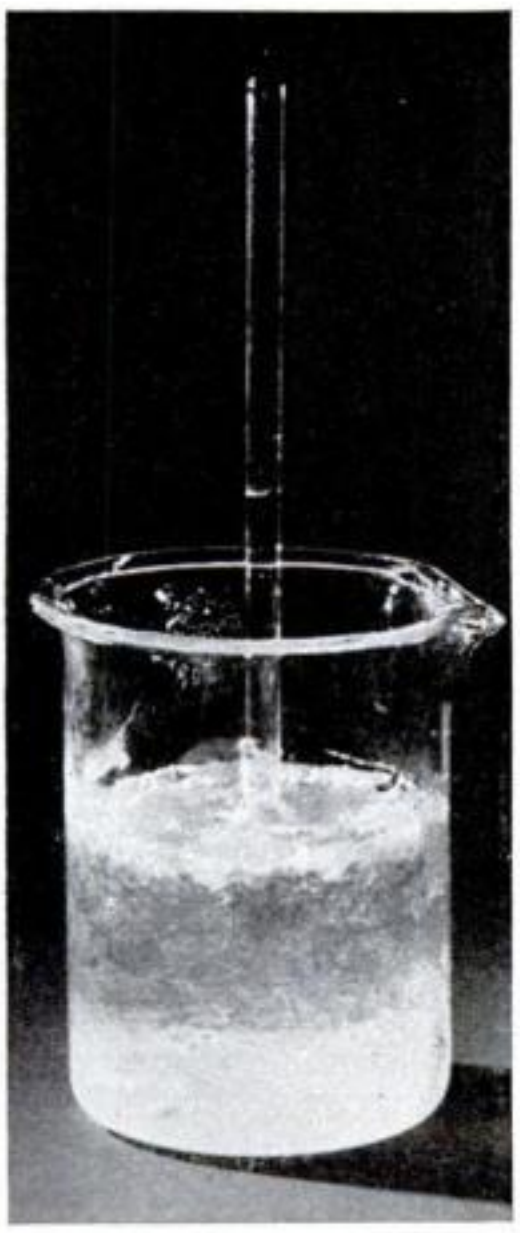
Ammonia is the easier of the two to make and use. Set up a 1-liter or 500-ml. round-bottom flask as indicated. It is important to use a round-bottom flask, for one with a flat bottom might be crushed by the air pressure. Pass through one hole of a two-hole stopper a long, straight glass tube drawn out to a jet at its upper end, and let the lower end dip into a vessel of water to which a little phenolphthalein solution has been added. Then pass a medicine dropper filled with water through the other hole.

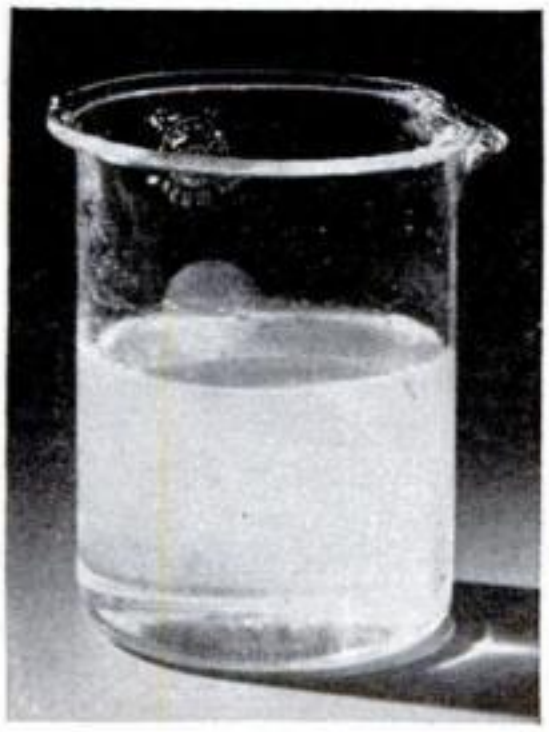
You may make ammonia in a flask like that shown at the left in the photo by adding concentrated ammonium hydroxide through the thistle tube to sodium hydroxide pellets on the bottom. Remove the stopper from the round-bottom flask and lead ammonia gas into it from the generator through a rubber tube. Being lighter than air, it will displace the air downward. When an ammonia smell issues from the bottom, remove the rubber tube, and stopper the flask tight.

Now squeeze water from the medicine dropper into the inverted flask. Ammonia will dissolve, and a partial vacuum will be created, causing water to rise from the lower vessel and squirt out of the jet. Since ammonia is an alkali when dissolved, it turns the phenolphthalein in the water pink.

As more water enters the flask, more and more ammonia dissolves, and the vacuum becomes increasingly greater. The water shoots up faster and faster, splashing against the top.

Supersaturated solutions may be liquid one moment, solid the next, as below and at right. Make one by heating hypo crystals to get a solution like that below. If you allow it to cool quietly, nothing happens, but then add a single extra crystal, and the mass soon solidifies



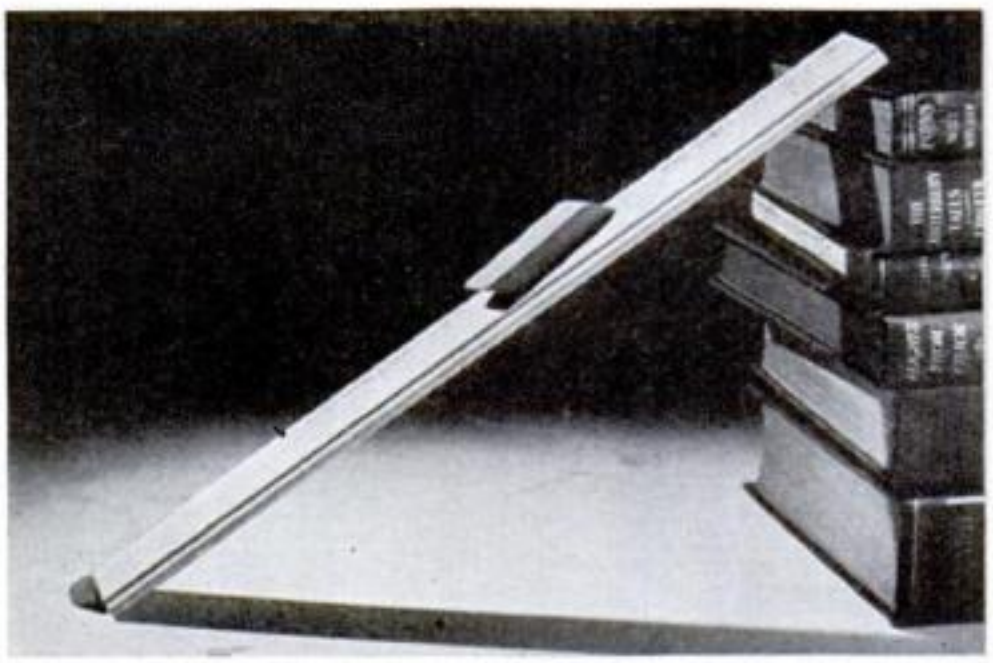


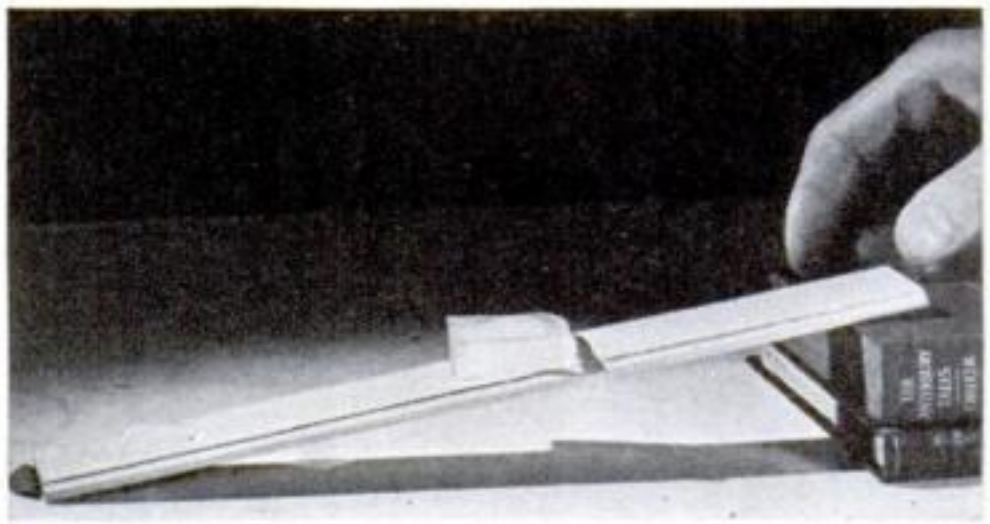
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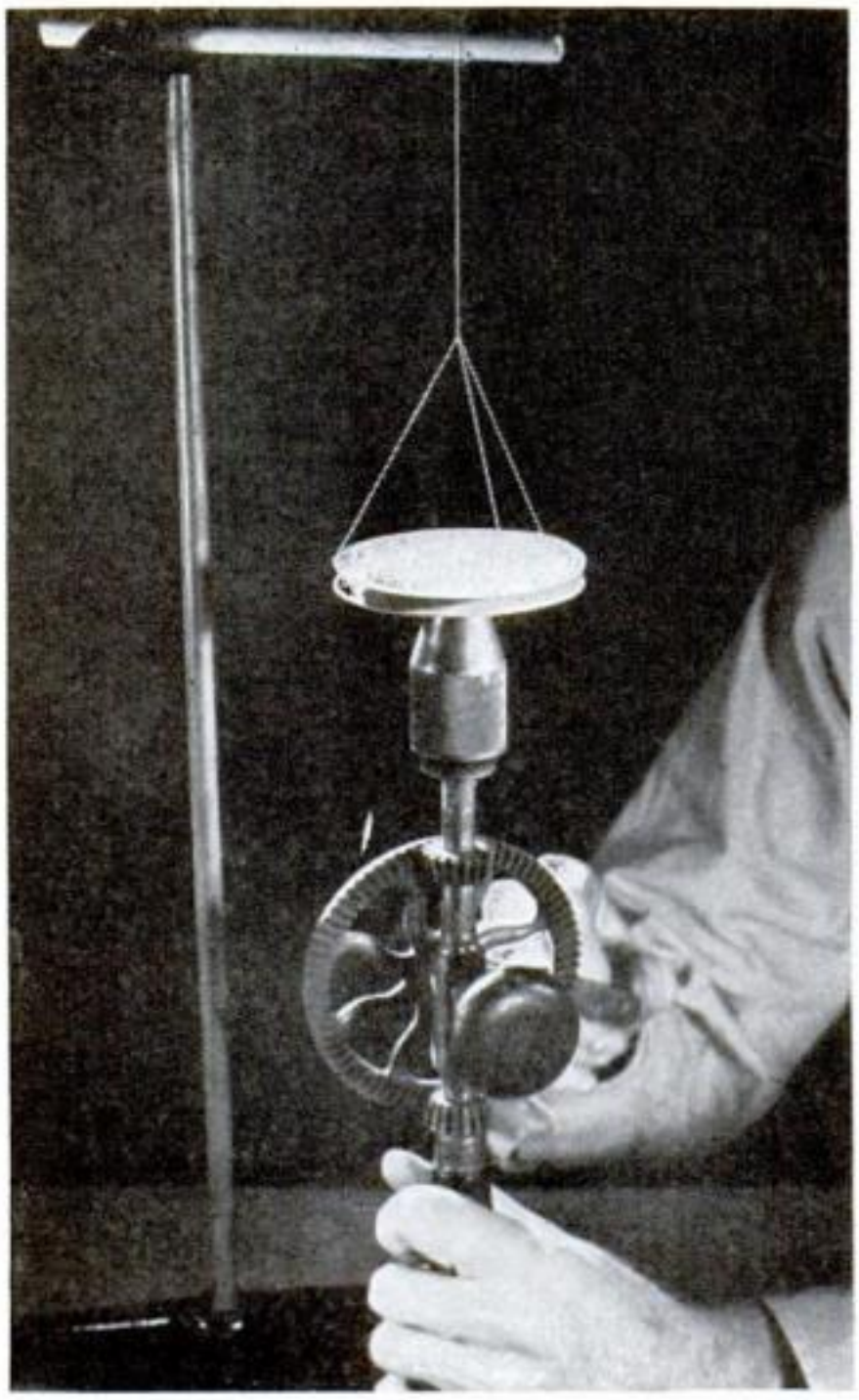
FRICTION IS RESISTANCE to the movement of one object or substance over or through another. When we walk, row a boat, pull a sled, drive a car, or fly a plane, we encounter friction either as a help or a hindrance. If we want something to move readily, we seek to reduce friction; if we want an object to grip another, we try to increase friction.

The relative amount of friction between two given substances is called the *coefficient of friction.* You can study friction at first hand, and learn about this coefficient, by means of a common ruler and several different household objects. Raise one end of the ruler to the minimum height necessary for the *moving* object to slide all the way down. You will have to start the object, for starting friction is greater than that during motion.

Try using an eraser for the sliding object, and you will find that you will have to raise the end of the ruler comparatively high, as shown at the upper right. To find the coefficient, divide the height of the end by the base of the triangle formed.







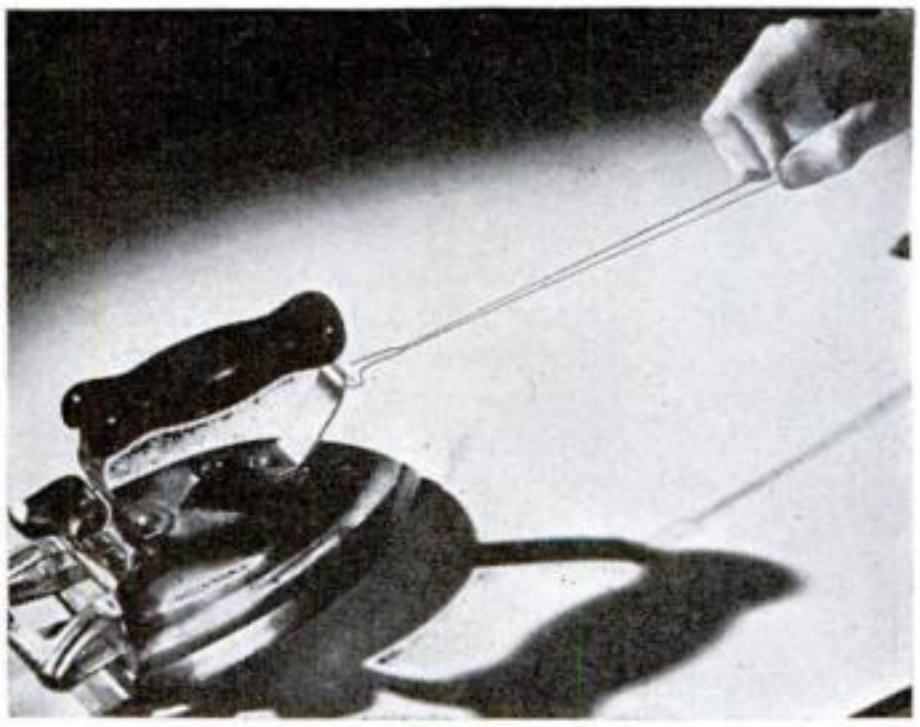
SUBSTITUTE AN ICE CUBE for the eraser, and you will discover that the end of the ruler can be set very low, as shown above. Instead of a high coefficient of friction, as with the eraser, the coefficient will be low—reduced by a film of water between the ice and the ruler. Oil films similarly reduce friction between machine parts.

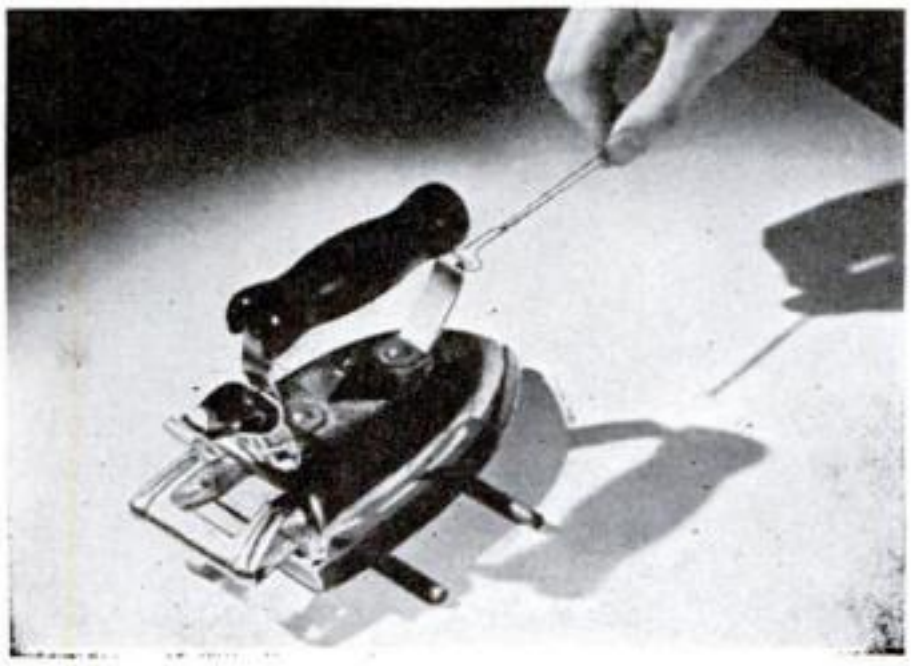
MOLECULES OF FLUIDS as light even as air provide friction as well as do solid materials. The friction of air molecules against the sides of fast-moving trains, automobiles, and planes is an important retarding force. A thrown baseball curves because of the reaction between still air and air that is dragged by friction around the whirling ball.

You can prove that air exerts frictional force between its molecules and against solids by means of the simple apparatus shown at the left. Suspend the upper cardboard disk freely by fine wire or thread, and rotate close to it a similar disk mounted on a hand drill. When the disk on the drill is rotated fast enough and steadily enough, air friction between the two will twist the upper from its original position, and eventually it will start this disk rotating in the same direction as the other.

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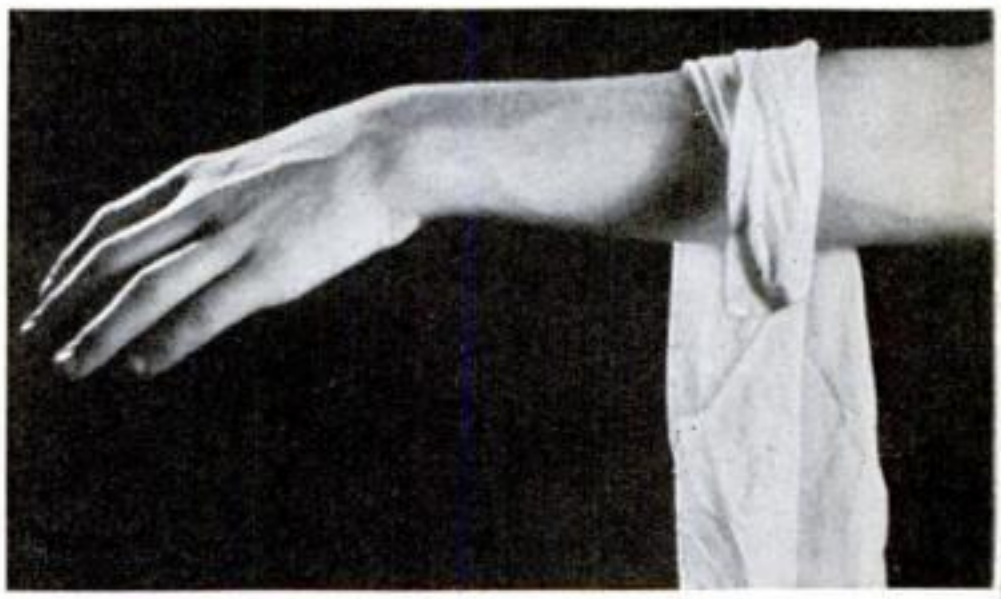
WITH FRICTION





IN SLIDING OR ROLLING, an object encounters friction. Attach a moderately strong rubber band to a flatiron, as shown in the two photos at left, and note the amount of stretch when you slide the iron over a table. Now place two round pencils under the iron to serve as wheels. There will be hardly any stretch when you pull the rubber band.

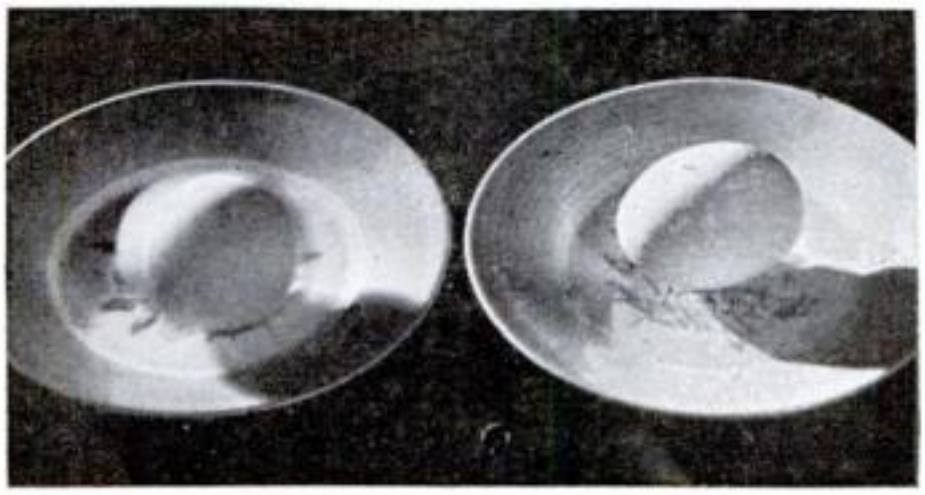
Though it's generally easier to slide an object than to lift it, the force of friction is ordinarily too high for efficient movement unless both surfaces making contact are exceptionally smooth. Sleds move swiftly over ice and snow because pressure melts water under the runners and provides a lubricant. Extreme cold reduces sled speeds.





HOW STARTING FRICTION acts can be shown by draping a handkerchief or a towel loosely over your arm, as illustrated in the upper photo at right. Have one end of the cloth hang down much lower than the other. If you keep your arm still, the considerable starting friction will hold the cloth in place even when one side is much heavier than the other.

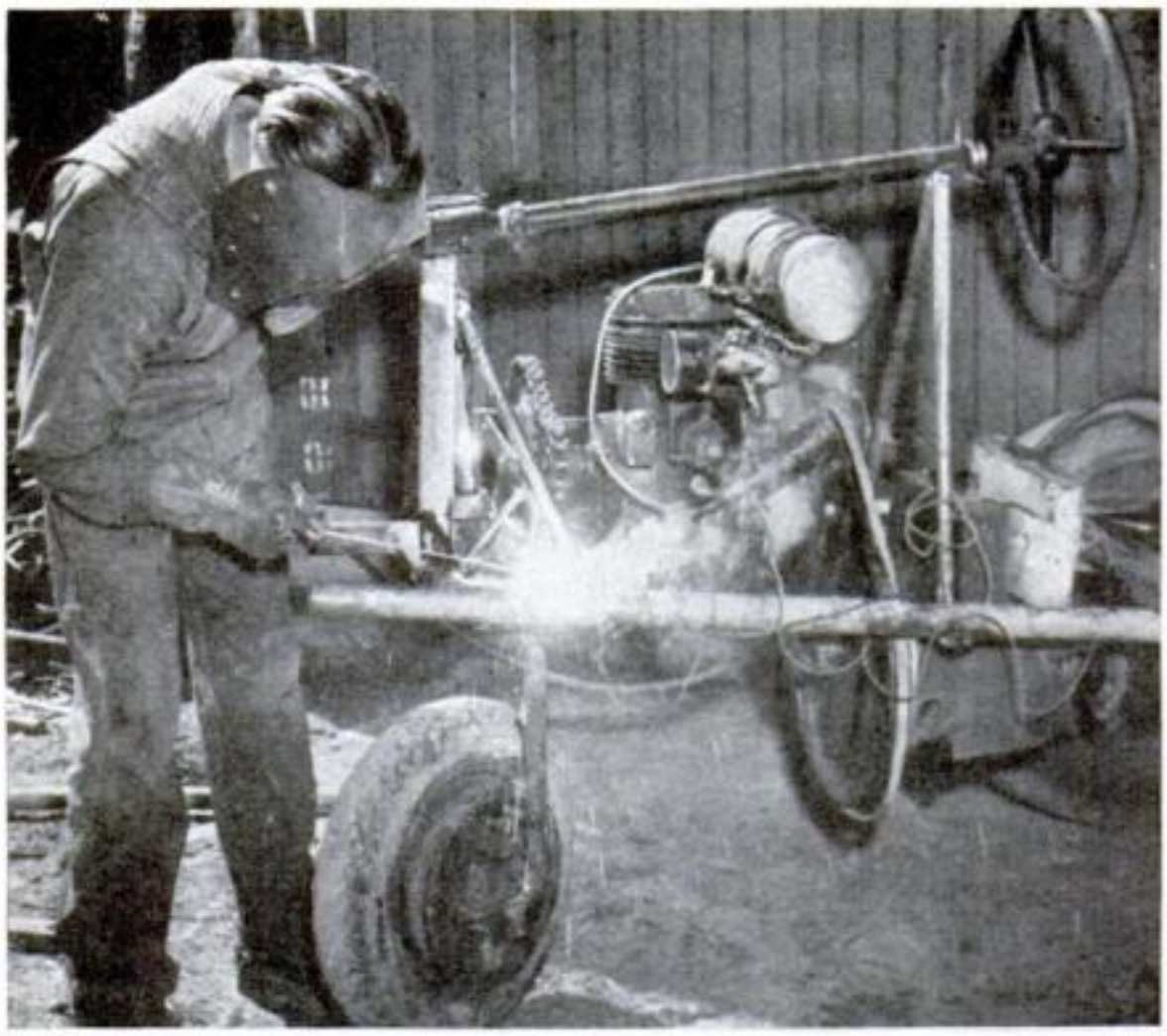
Lower your wrist, though, so that the slope will overcome the starting friction, and the handkerchief will begin to slide down your arm. As a result, in addition to sliding down, the handkerchief also will be pulled down on the heavier side. Once the starting friction is overcome, the unequal weight will cause it to drop off.



SPINNING AN EGG is an easy way to demine if it is raw or hard-boiled. Place an egg of each kind in saucers and spin them. The hard-boiled one will turn for some time because friction between the saucer and the point of contact on the egg is slight. The raw egg will waver and soon stop. Friction contributes to this behavior in several ways. The loose yolk, moving within the fluid egg-white, sets up molecular friction. It also unbalances the egg, creating a series of contact points between shell and saucer, and thus producing in effect a larger area of frictional contact than with the boiled egg.

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Farmers Turn Mechanics



This homemade garden tractor, built by Louis Bellatti, of Illinois, symbolizes the ingenuity used to combat shortages of farm equipment

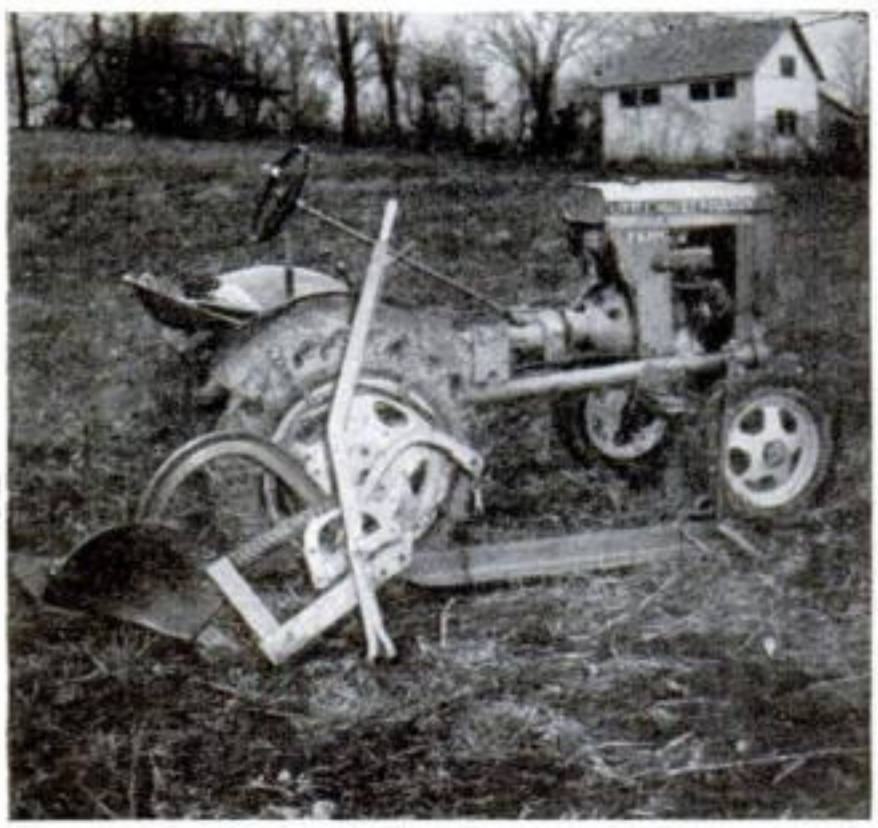
CALLED upon to feed an America at war and her Allies as well, farmers throughout the nation have for the past three years not only put their shoulders to the plow, but have also put them behind the hammer, the wrench, the lathe, and the welding torch. For American farmers, deprived when they needed them most of sufficient new machines for their gigantic task, have built their own and maintained them with the thoroughness of expert mechanics.

What some of them accomplished is indicated in the series of accompanying photographs. Several of the machines shown were built from scratch; others were salvaged from junk yards. All are seeing service on farms in Illinois, New York, and Ohio.

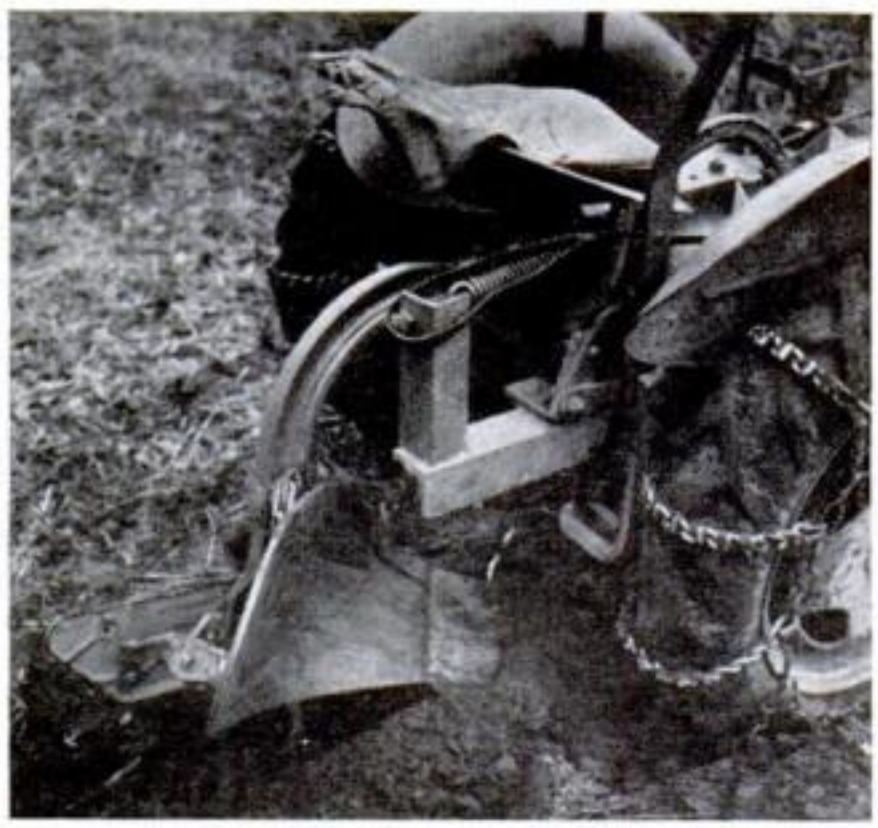
This same activity has been going on from Maine to California. Often farmer-mechanics have had the help of instructors and tools at some 6,000 shops operated in connection with farm-machinery repair courses of the U. S. Departments of Vocational Agriculture and Food Production War Training and sponsored by local public boards of education. What they have done, you can do too—with old, discarded machines, with pieces found in junk yards, and with parts from the scrap heap.

Louis Bellatti, of Mount Pulaski, Ill., has his own electrically equipped farm workshop. Salvaging parts from the scrap heap, he spent exactly $20 to construct a garden tractor plow. At present he runs it with a Fairbanks-Morse engine taken from his dis-

Converted from a horse-drawn tool to one for use with a tractor, this plow is shown set up in the relative position the parts occupy when mounted



Out of the soil, the plow hangs free just under the tractor seat. The heavy spring is needed to counterbalance the assembly which weighs 100 lb.



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to Feed America

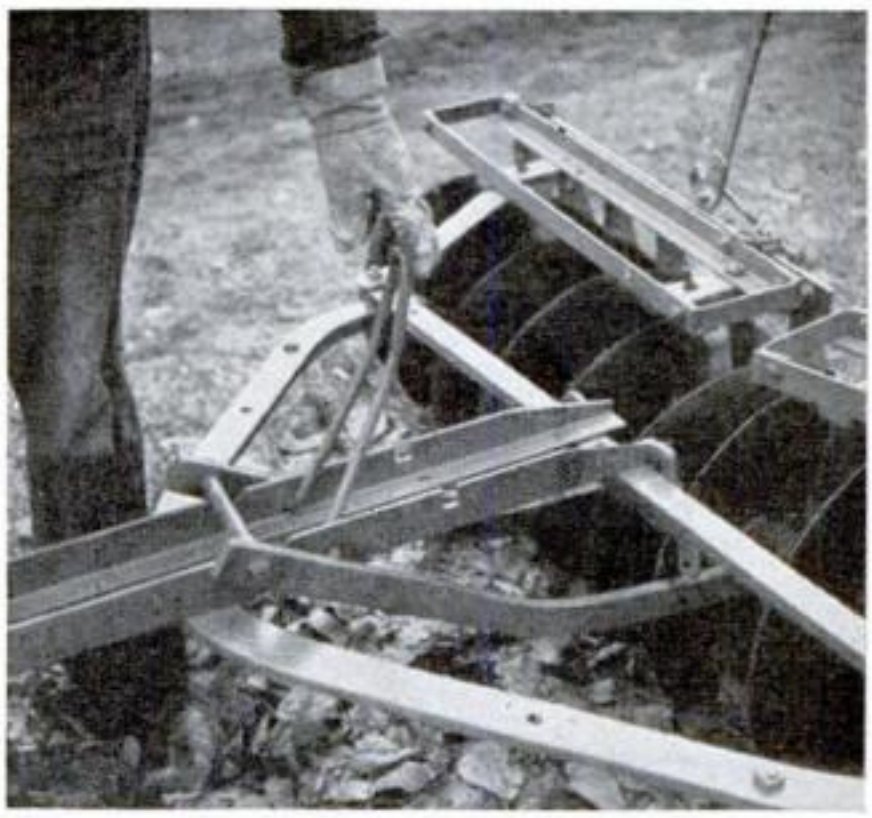
carded home light plant, but he expects soon to add a 9-hp. air-cooled motor at a cost of $140 more. With the new motor, his tractor will walk a 12" plow at 3 m.p.h.

At Sauquoit, N. Y., George H. Smith operates a 22-acre farm. He has provided it with rebuilt, converted, and reclaimed tools including a tractor plow, a lime and fertilizer sower, a disk harrow, and a potato digger. Some were made over from tools originally intended to be pulled by horse. Smith uses the smallest John Deere tractor for his motive power.

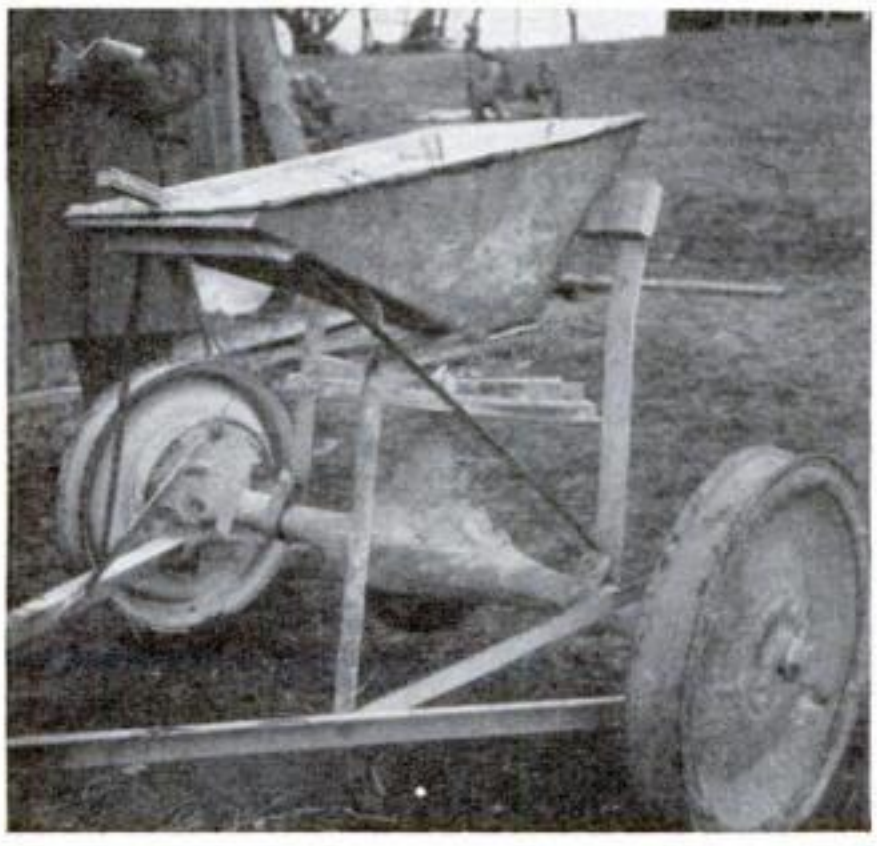
The integral plow shown on the facing page can be mounted on the tractor in 20 minutes and removed in 15 minutes. It is arranged to be drawn from the front of the tractor in such a way as to pull the tractor to earth when a root or rock obstructs forward motion. In good soil, the plow will turn a 10" furrow. Smith already owned the horse plow from which the tractor plow was made, and he spent $6 for angle iron and bolts and for bending and welding. He values the plow at $50 as a tractor tool.

A rear axle from a 1924 Essex and miscellaneous steel parts, including a steel barrel head, gave Smith a lime and fertilizer sower. He turned the axle 90 deg. so the universal-joint coupling would extend upward, and attached to it the steel barrel head which had been fitted with band-iron paddles to form a turntable. It will throw fertilizer and lime 25' to the sides and rear. The hopper, a simple box structure, is mounted slightly to one side so the contents will be kicked out to the the rear when a hand-controlled gate lets them drop to the turntable. Capacity is about two bags. Smith already had the old axle; he spent 75 cents for band iron and bolts, and values the sower at $35.

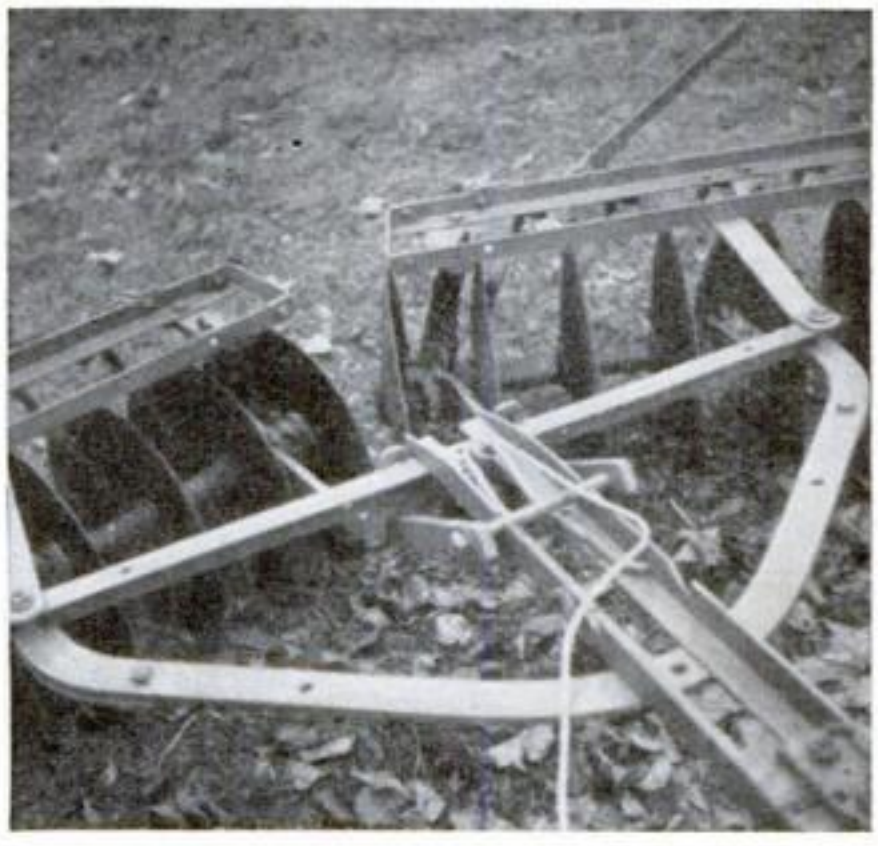
The disk harrow pictured was bought from a neighbor for $5 after it had been badly smashed against a boulder. With its old hand controls removed and with a trip-line handle, two sets of lock notches, and a ball-and-socket hitch added, the piece was made completely automatic and its value increased to about $80. Smith did all the work in three hours. [*Turn the page.*]



This reclaimed disk harrow was made automatic by adding the trip lever, shown above, which locks and operates the gangs in work and in transport position. Below, with the disks at an angle for work, the trip handle is locked. It is unlocked by backing the tractor and pulling the trip line



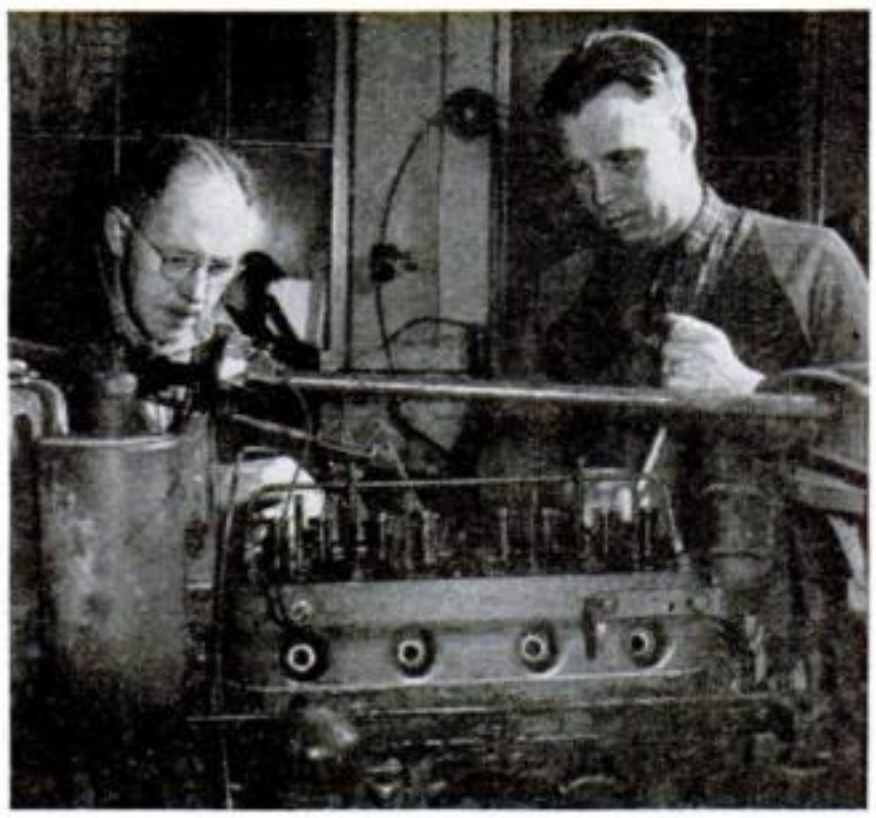
Fertilizer, lime, or seed flow from the hopper to a spinning turntable which is mounted on the universal-joint coupling of a junked automobile axle



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Here is a potato digger salvaged from a junk heap and rebuilt by George H. Smith, New York State farmer, who also converted the plow and harrow and constructed the sower on the preceding pages



Smith (right) at work on a tractor engine at the Sauquoit Valley Central School shop for training farm mechanics. He is aided by Merle L. Rogers, vocational agriculture teacher and shop supervisor

Another tool that Smith bought in bad condition for $5 was the 1910-model potato digger shown on this page. It had been left out of doors and had become so rusted that most of the identification marks of the manufacturer were gone. So long had it stood in one place that an elderberry bush had grown up through the elevator.

Reclaiming the machine required complete dismantling and thorough cleaning of all parts. Then Smith set about redesigning, assembling, and painting an entirely new potato digger. One gear had to be replaced, and new bushings were put in. The truck was discarded and the digger mounted directly on the tractor drawbar with a single bolt. Parts in addition to the original cost came to $6.90, but Smith wound up with an $85 machine.

Smith aims at three objectives in building and reclaiming farm machines. He considers safety of operation of first importance in homemade machinery; next, he wants efficiency in performance; and third, he looks for speed and ease in mounting a machine on the tractor—a matter of great moment during periods of increased production and decreased labor. Smith paints all machines and gets them under cover when they are not in use.

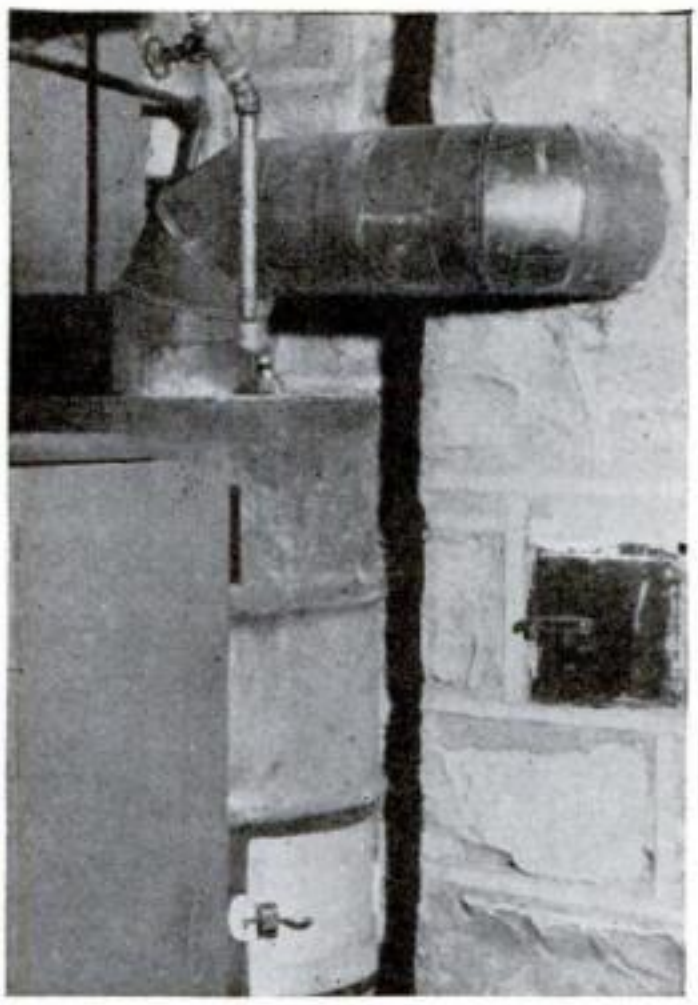
The tractor shown at right was built from an assortment of parts by H. O. Waag, of Dayton, Ohio. It consists of a 1928 Whippet motor and frame, the secondary transmission from a 1928 Chevrolet, and a worm-drive differential from a 1927 Model T Ford truck. The wheel base is 70", and the tread is 57½" for both axles to eliminate the danger of riding crops. Seat, steering column, and gas tank are raised, the first for better vision and the last to permit gravity feed. Waag plans to add a safety hitch and a governor. Parts for the tractor cost $52—$20 for the old Whippet, $25 for the rear axle and tires, $5 for the transmission, and $2 for bolts—and another $2 was spent for welding.

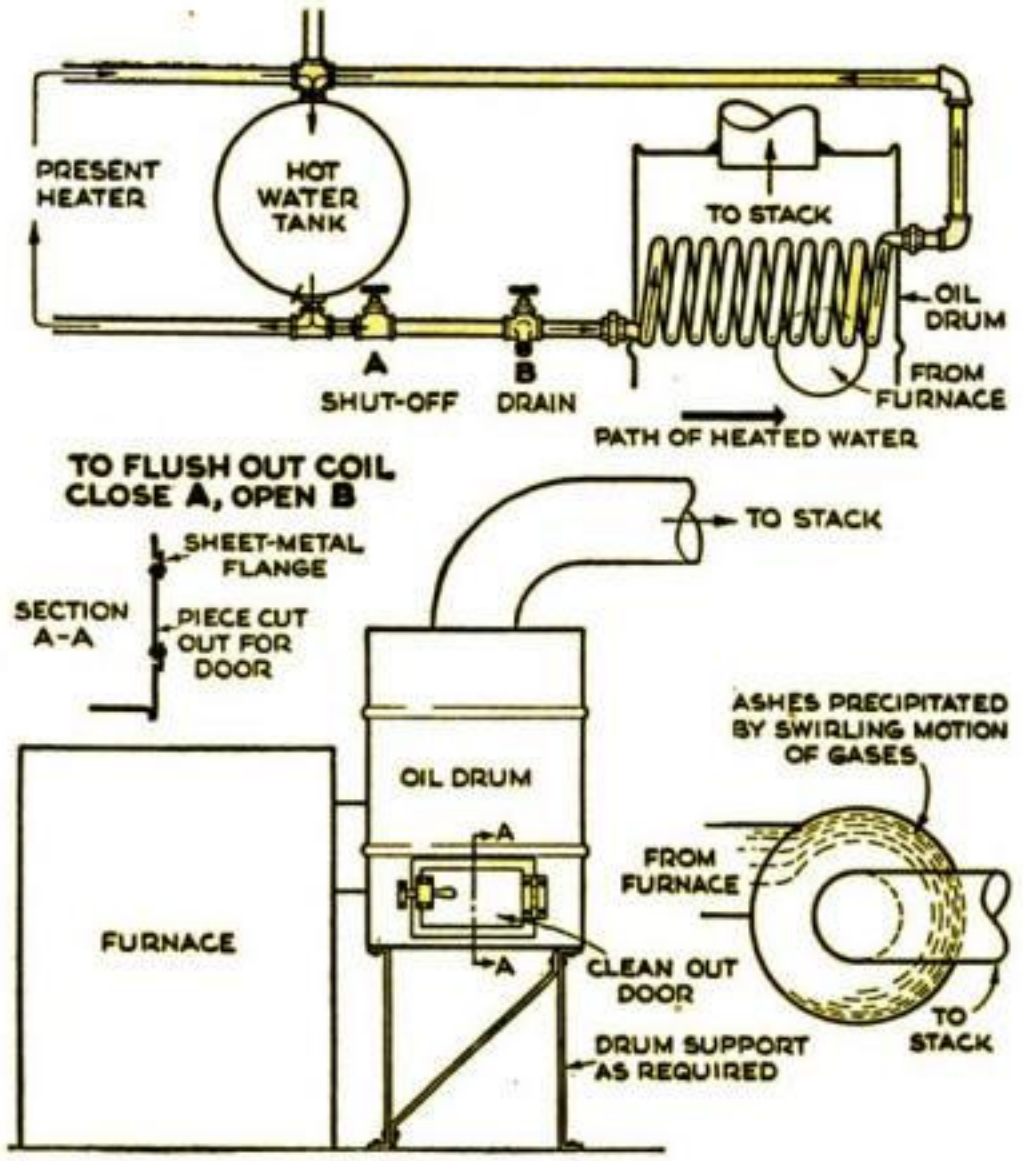
This is Waag's second home-built tractor. He still has in operation one made from a Chevrolet transmission and a Model T Ford with a two-speed rear axle. Both pull the same equipment: a 14" plow, a 14' disk harrow, a 14' drag, a two-row planter, several cultivators, and a 6' mower.



Whippet motor and frame, Chevrolet transmission, and Ford rear axle were used in this tractor built by H. O. Waag, an Ohio farmer

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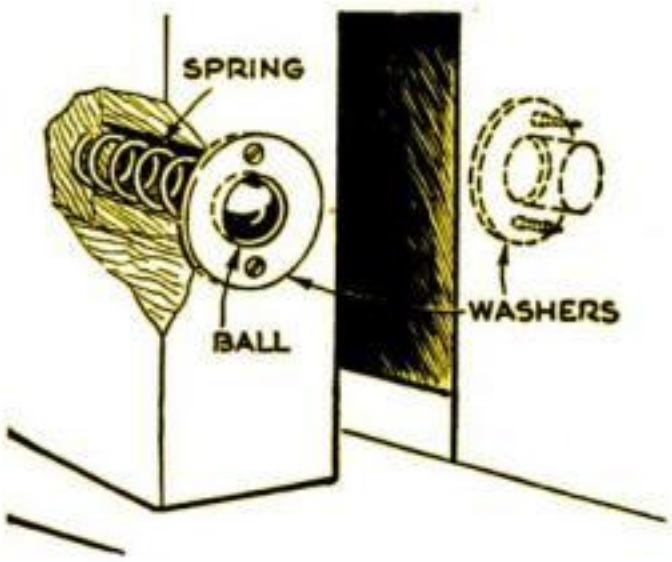
Fly-Ash Collector Acts Also to Conserve Fuel

MANY stoker-type furnaces burning low-grade coal waste considerable heat because of high-temperature stack gases. The velocity of the exhaust also often carries fly ash out the chimney to be deposited on walks and sills to seep into the house.

Both the waste heat and fly ash can be trapped by installing a 55-gal. oil drum between the furnace and chimney. Centrifugal action in this chamber swirls the ash against the sides and it drops to the bottom where it can be collected. The clean, hot gases at the center are slowed down and lose much of their heat before escaping up the chimney. This heat may warm the basement or, by provision of a coil, it may be used for supplementary water heating.

The pipe from the furnace enters the drum at one side to cause the gases to swirl. Cut the hole for it and one for the pipe to the stack with a wide chisel driven along the metal so as not to bend it inward. These holes need not be exact fits, for powdered asbestos cement will calk the joints. The door opening, however, should be cut cleanly since the piece cut out is framed with a sheet-metal flange and used for the door. Attach hinges and a cabinet or refrigerator latch with small bolts.

A copper coil from an old gas heater makes a good water-heating unit. If it is short, the soft copper can be "stretched" longer. Joints requiring rubber gaskets must be placed outside the drum as the rubber will not stand great heat. Be sure to connect the circuit as shown in the drawing, for otherwise water will not circulate properly. A horizontal coil should be flushed after installation to get rid of trapped air within it.—W. E. LANG.



Bearing Ball Used In Friction Catch

For a satisfactory friction catch, try a small coil spring, a bearing ball from the junk box, and two washers. Bore the edge of the cabinet door to a depth somewhat less than the length of the spring and counterbore for one washer. Press the spring in with the ball, which should be slightly larger than the washer hole, and fasten the washer with two small, countersunk screws. Attach the other washer to the opposite door or upright for a striker. Oil to prevent rust.—KEN MURRAY.

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Sponges Grow on Trees

(Continued from page 135)

needed. Three different types of sponges, for such common purposes, are made at the Du Pont plant in Buffalo, and a fourth type has been produced to meet specific requirements.

There is a soft, thin skin around each sponge block when it is removed from the molding can. This skin is formed by the fluid viscose being pressed against the smooth sides of the container. There are no large pores in this skin because the fluid and the fiber keep the crystals, which leave such holes, away from the sides of the mold.

This skin, usually trimmed off, is left on some sponges so that they may be used both for washing and wiping.

Auto-washing sponges are made in molds of oval cross section. Each block is then sliced in half, making two sponges. The soft skin is left on the outer side to make the sponge easy to hold, and to permit the user to grip it firmly without squeezing out too much water. The large pores of the straight side can be used to scrub a car. Then an experienced cleaner can turn the sponge over and use its smoother outer side as a chamois.

All sponge blocks are inspected with X ray before being cut. This is done so that any pebbles, bits of wood, or other hard material that may have gotten into the sponge mix may be removed. The sponge blocks are then cut to the desired sizes and shapes with knives or saws, depending on how smooth a surface is desired.

Most of the Du Pont sponges are brick-shaped. Flat surfaces are preferable to the irregular surfaces of natural sponges, not only for most kinds of scrubbing, but also for such industrial work as making pottery. Square-cornered sponges, furthermore, are less likely to roll away if dropped.

These sponges can be sterilized by boiling without damage. Cleaning compounds, soaps, greasy matter, or grit will not harm them. They are about as impervious to chemicals as your shirt. Users are advised to squeeze rather than twist these sponges to dry them, lest the fibers be weakened, but they can stand considerable hard use.

A mop made of synthetic sponge blocks can be wrung out simply by pressing it against a wooden grill on the edge of a bucket. Properly handled, one artificial sponge can be used to wash an automobile 150 times or more. A synthetic sponge that was run through an ordinary household wringer 10,000 times, just to test it, showed virtually no signs of wear.

When dry, a synthetic sponge feels harder and tougher than a good natural sponge, but it becomes soft and pliable when wet. Cellulose could be made into spongy material that would feel more silky, but the producers have concentrated on other, more important qualities.

Sponges can be made with different degrees of compressibility by varying the manufacturing process. Some synthetic sponges can be squeezed to about a third of their normal size when dry, to save shipping and storage space, and will remain compressed until moistened. Such sponge cakes are put in life rafts, to be used either for bailing out sea water or for holding fresh water.

Although most of the hearty-drinking substances made thus far have been intended to hold water, cellulose sponges also can be used to hold lubricants in mine-locomotive journal boxes. They are reported to give more positive contact with the axle than wool or cotton waste, and to provide more uniform lubrication.

The Du Pont chemists have even made a choosy synthetic sponge that will absorb gasoline but not water. It is made the same as other sponge material, but is treated with a chemical that repels water. Such sponges have been placed in the wings of warplanes to drink up whatever gasoline might escape when a bullet penetrated a self-sealing fuel tank.

Three U. S. Department of Agriculture research men recently suggested that synthetic sponges also be made of frozen cornstarch for use as internal surgical dressings. Such dressings could be left in the body after an operative wound was closed, and would slowly dissolve and be absorbed by the body along with the medical substances in them.

More uses for man-made sponges are constantly being found, and many more kinds can be manufactured. Du Pont chemists believe, however, that more synthetic sponges will be used in American homes than anywhere else.



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You'll Live with Plastics

(Continued from page 123)

success has come only in the past year or two. What is the result? For one thing, an insulating material so resistant to heat that it has revolutionized the design of electric motors. By its use, a motor of given horsepower may be made only one third as large and heavy as before. For another, there are new oils that remain fluid at 50 degrees below zero. And these improvements are only the beginning.

Among the brand-new uses for well-established plastics is one that will mean a lot to fishermen. By impregnating bamboo strips with waterproof phenolic resin and gluing them with an adhesive of the same type, which is really waterproof, a fishing rod has been produced that will not come apart if it gets wet. Heretofore, the finest rods had to be kept well varnished or they would fall to pieces. The impregnated rod never needs to be varnished at all. The Charles F. Orvis Company is the first to employ this technique. The plastic-treated rod has been tried out by expert fishermen who have reported enthusiastically as to its qualities. The same company also has furnished the Army with ski poles, also of bamboo, made in the same way, and these are reported to be lighter and stronger than steel. The manufacturer is now experimenting on such articles as golf clubs, billiard cues, archery sets, and furniture.

Plywood is an old story, but not the kind of plywood we have now, which can be immersed in salt water in the form of boat hulls, for instance. Not so well known is the lamination of canvas and other fabrics with plastic impregnation and binder. The resulting material has been used by the ton in place of metal parts in planes, boats, trucks, and almost any kind of military equipment you could mention. It can be made actually stronger, pound for pound, than sheet steel or any other metal. Much of this development was brought about by the shortage of metal. The plastic material, entering new fields as a substitute, has won a permanent place on its merits.

At the same time, new and simpler techniques for molding the combination materials have been evolved. It was upon their moldability, in the first place, that plastics entered into competition with common materials. This quality is being improved upon constantly, and the machinery in which it is done has been undergoing similar improvement.

The plastics industry is an infant, but it is learning fast, and incidentally is showing its elders a thing or two.

Are Spiders Our Friends?

(Continued from page 127)

ing technique. He enters the female's web and builds a nest right up against hers. Then he starts knocking on the partition. Sometimes he keeps this up for days until he gets the "all clear" from the other side.

Dr. Petrunkevitch has spent hours observing the dancing of some varieties of male spiders, another form of courtship. They go through odd gyrations, circling around the female, waving some of their legs in the air, dipping, swaying, and taking fancy steps of all kinds. Eventually the female may join in the dance, circling around the male.

Still another species of male spider brings a nice, fat bug, neatly wrapped up in silk, and presents it to his ladylove. His natural appetite sometimes gets the better of him, however, and he will suck all the juice out and present the dry shell to the female.

Spiders cannot breathe under water, but some of them actually live and bring up their young in nests below the surface. They carry air down with them in the form of bubbles held in the hairs of their bodies. One variety builds a nest like an inverted thimble attached to a grass root at the bottom of a pool. The female fills this with air which she carries down, bubble by bubble. There she mates and hatches out her young.

One of the strange phenomena in spider life, which Dr. Petrunkevitch has watched time after time, is the killing of the great tarantula by the "tarantula hawk," a giant wasp, of Puerto Rico. Big and strong as he is, the tarantula seems to be completely terrorized by this enemy, or perhaps hypnotized. At any rate, he makes no effort to defend himself. The wasp will approach its victim and then suddenly run under his belly. The spider makes no move except to raise himself as high as possible on his long legs, then stands in this odd position as if frozen stiff. The wasp then seizes the spider by one leg, throws him with a sort of jujitsu hold, darts in and stings him, and it's all over. The tarantula loses consciousness immediately, but does not die. He is not supposed to. The wasp drags him to her

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burrow in the ground, lays an egg on him, builds a roof over the top, and then deliberately camouflages it so that it looks like the surrounding ground. The tarantula will be fresh food for the wasp's larva. Dr. Petrunkevitch has kept a tarantula alive for six months while it was thus "anesthetized."

If you should ask the doctor, he would tell you to kill off the wasps but not the spiders. The burrowing wasps of this country, and also the common mud-daubers, use this same technique of injecting their poison into spiders and leaving them in their nests for their young to eat.

He does not approve of killing even the black widow, because this spider destroys many insect pests. Keep them out of your house and outbuildings, he says, and they will do no harm. He does not deny that the black widow's poison is virulent and has even caused a few deaths.

The hostility of people to spiders in general is painful to the doctor, who knows so well that the vast majority of them are harmless and that they are benefactors to man. If insects are the greatest menace to mankind, as some scientists assert, then Dr. Petrunkevitch is quite right in calling the spiders our best friends among the lower animals.

Malaria

(Continued from page 108)

remain immune—Jonahs in the mosquito's stomach.

And now a spectacular thing occurs. A male cell throws out from four to eight streamers, which detach themselves from it. When one of these members comes in contact with a female cell, the streamer penetrates and fertilizes it. Finding its way to the mosquito's stomach wall, the fertilized parasite attaches itself and contracts into a walled cyst. Upon maturing, the cyst bursts and emits from several hundred to several thousand spores into the body cavity of the insect. Migrating to all parts of its body, many of the spores enter the salivary glands of the mosquito. And when Ann bites the next man, she scores another infection.

Where can the cycle be broken? First thought goes to the patient, both for his own sake and for others he may indirectly infect. For attacking the parasite in its early stages, up to the time that it bursts the blood cells, both quinine and the newer drug, atabrine, have been found effective. Against the mature sex cells, neither drug has been found useful, but another called plasmochin kills them. Treatments with such combinations of drugs as atabrine and plasmochin, therefore, seem to offer the best possibility of cure.

Triphibious warfare against Ann herself, however, has been the grand strategy of the Army's antimalaria campaign. A-20 Havoc planes have successfully attacked her water-dwelling larvae. Flying in formation, the low-skimming craft dust ponds and marshes with a powdered insecticide called DDT—a happy abbreviation for its ponderous chemical name, dichloro-diphenyl-trichlorethane. Since the "cruising range" of malarial mosquitoes seldom exceeds a mile from where they breed, the area around an encampment may speedily be protected.

Insect-killing "grenades" make short work of all adult malarial mosquitoes in a room. Opening a valve on a black cylinder, six inches high and 2½ inches in diameter, releases a persistent and all-permeating mist of an insecticidal vapor, consisting of pyrethrin suspended in a type of gas used in mechanical refrigerators (P.S.M., June '44, p. 56A).

"Malaria discipline" for troops includes sleeves rolled down, long trousers, and anti-mosquito boots after dusk. Jungle headgear provides a screen of netting enclosing the wearer's head. In these simple, common-sense ways, infected mosquitoes are prevented from getting a chance to bite.

Rumor has made a bugaboo of possible malaria epidemics, when our troops come home from war theaters where they have contracted the disease or have been exposed to it. "Nonsense" is the substance of an official War Department reply. Of course it would be taking needless chances to discharge these troops without a careful medical checkup. Routine procedure to carry this out, as promptly as safety precautions permit, has already been set up under the office of the Surgeon General of the Army.

Supervision of possible malaria carriers among returning service men, in fact, contrasts with absence of control among civilians within the United States. There is nothing to prevent a Gulf Coast resident, for example, from carrying the deadly *falciparum* parasite to any part of the country. This probably accounts for recent outbreaks of malaria in Iowa, Minnesota, New Jersey, and Ohio—all relatively small and quickly controlled. Their speedy suppression presages what may be accomplished when all the resources now devoted to human warfare may be released for a campaign against the common enemy of all mankind.

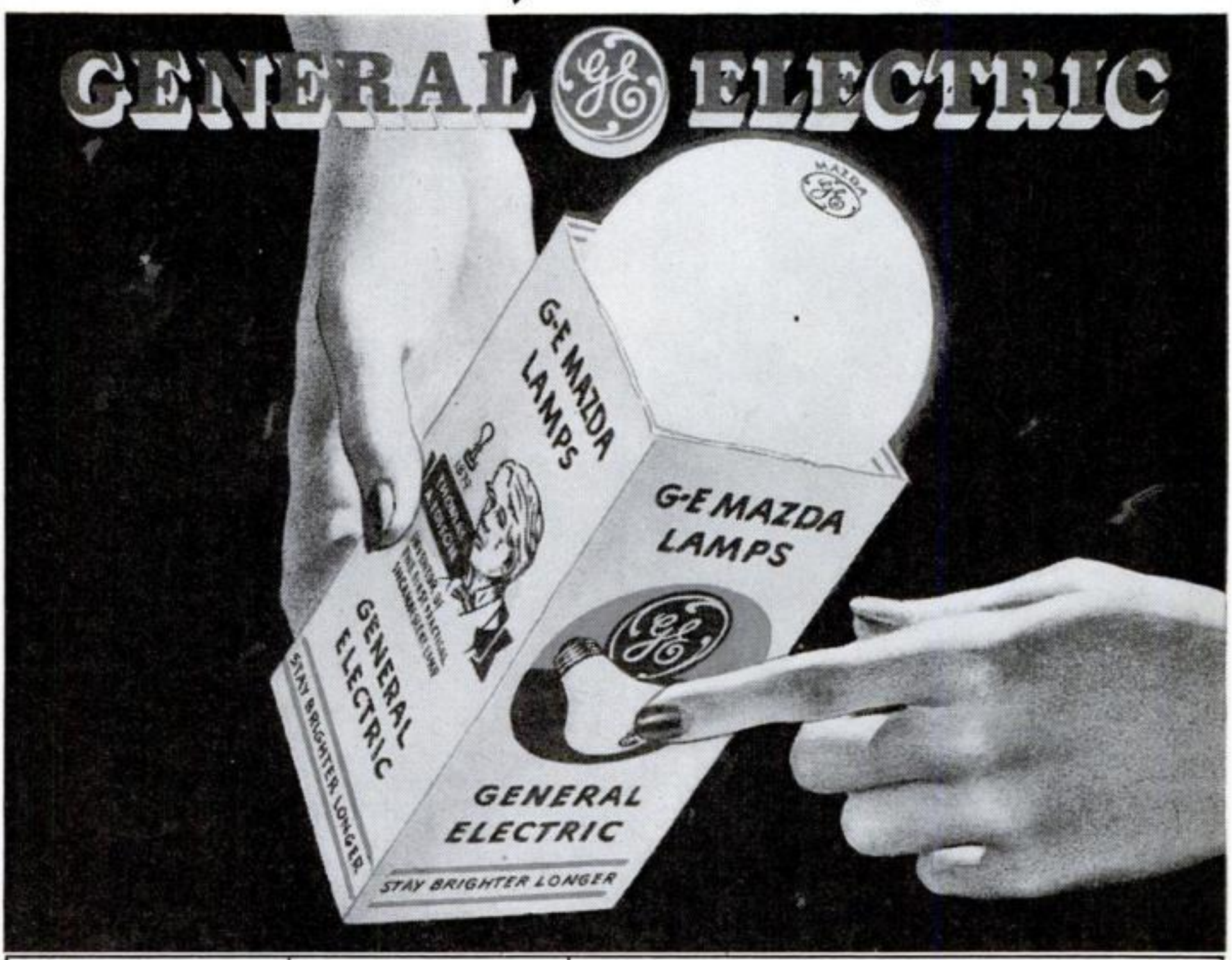
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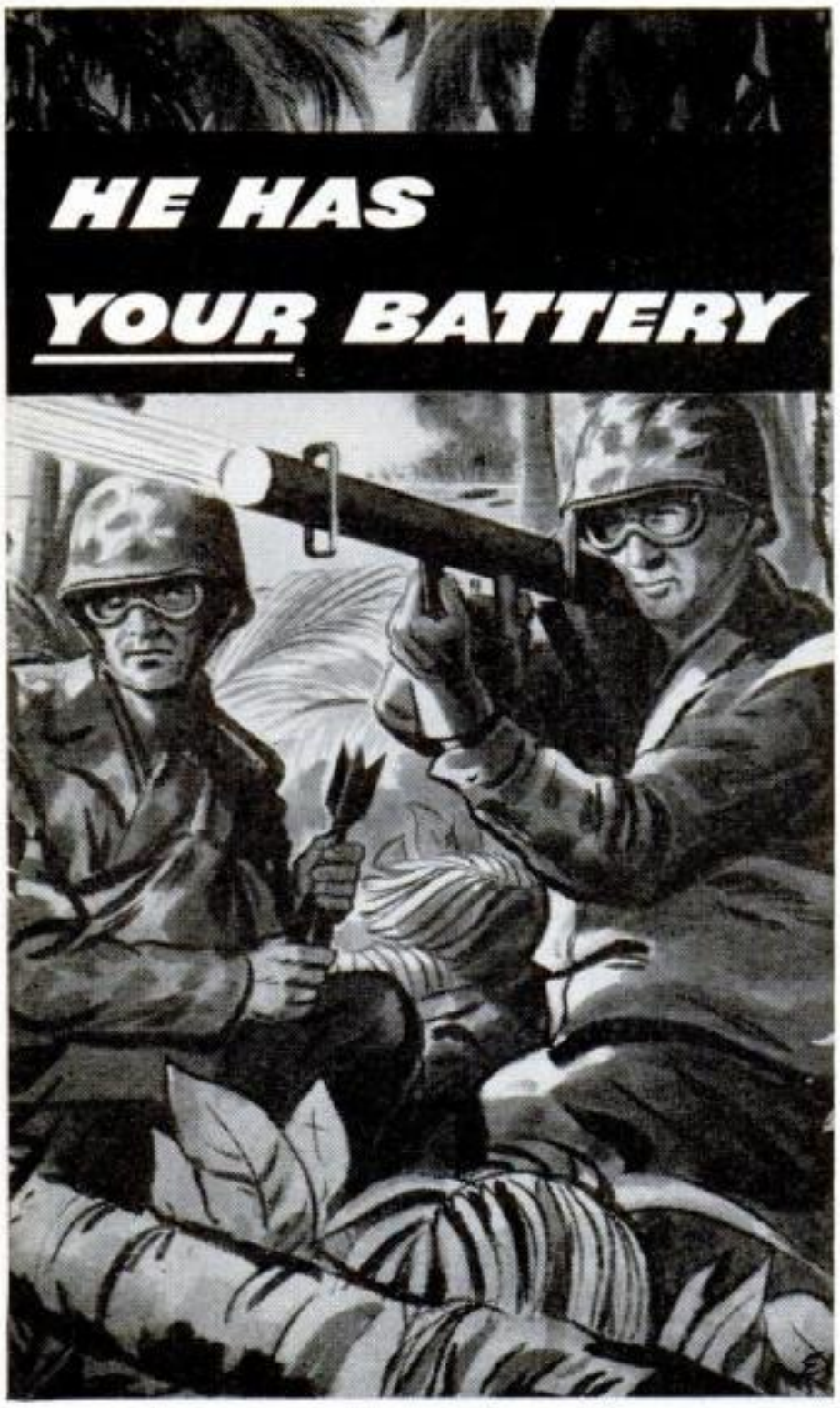
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IN THE NATION'S SERVICE

Death Flies at 50 Feet

(Continued from page 76)

naval and merchant ships were sunk or crippled in masthead-height attacks, including a light cruiser, three destroyers, two DE's and a 10,000-ton tanker. The squadron never kept track of the barges, sampans, landing ships, and sailing vessels it sent to the bottom as the pilots ranged far beyond their sectors to attack and destroy, sinking ships in the best-protected harbors.

These attacks were made by single planes flying alone, and all these attacks were made at low level—50 to 200 feet altitude. A very large number of them were made at night. Commander Miller and his pilots believe thoroughly in the lethal effectiveness of low-level bombing, and the squadron trained from the start largely in masthead-bombing tactics alone. Two hundred feet was the standard bombing altitude and 200 miles per hour indicated the speed. With a delayed-action bomb the plane is clear of the bomb blast when it explodes and ready to get back down on the water and streak for home. And, at masthead height, it is almost impossible to miss with your bombs. What *is* missed can be pretty completely demolished by the plane's machine guns. The pilot of a PB4Y does his own bombing and the pilots of VB-109 devised a bombsight that worked better than all the mechanisms so far invented.

There is such a long nose on the Liberator that the pilot can't see anything below. The target is under the nose when the bombs go. But, by constant practice against land and water targets with real bombs, the boys learned to drop their bombs when a two-inch-long piece of masking tape stuck to the windshield, the "V" made by the port pilot tube and the nose of the plane, and the waterline of a ship were all lined up. With experience, the bombs just don't miss.

Low bombing has been generally considered the toughest of assignments, but these boys preferred it. They felt safer doing it and actually came to fear the few times when they were required to bomb from higher altitudes. In all their single-plane, low-level attacks, not a plane of the squadron was lost and only one man was killed by flak in 7½ months.

Much of the success and safety of these low attacks is explained by the fact that they nearly always caught the Japs off guard. The Japs never detected the attacking plane coming in so low until it was in plain sight—much too late to deflect the AA guns and bracket the plane. The boys

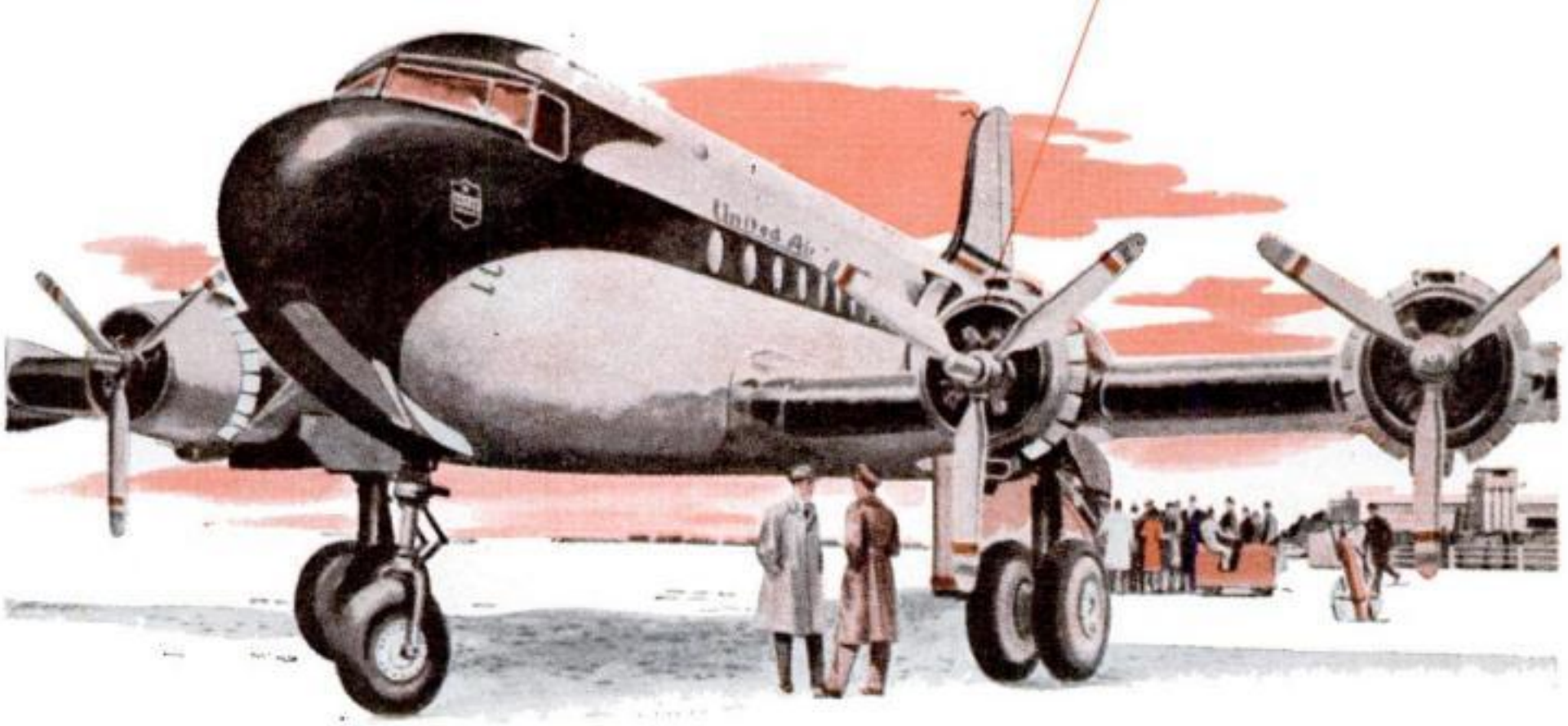
(Continued on page 216)

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UNITED AIR LINES

WHERE MAINTENANCE OF SCHEDULES REALLY COUNTS . . .





..CHAMPION SPARK PLUGS *INSURE MAXIMUM DEPENDABILITY*

Looking ahead to the days of peace, United Air Lines recently announced placement of orders for 50 four-engined Douglas luxury liners for immediate postwar use. Meantime United has set exceptional performance records in the service of the nation, both military and civilian, by operating almost 100,000 schedule miles daily with less than two-thirds the number of planes used to fly 81,000 schedule miles in 1941. Champion Spark Plugs now used exclusively by United on its Mainliners and Cargoliners have contributed substantially to this outstanding service record. Thus once again Champion Spark Plugs demonstrate in an exceptional way the inherently high caliber of their dependability—dependability that has established Champions as the preferred spark plug for all types of service on land, water and in the air.



TO SAVE GASOLINE —KEEP SPARK PLUGS CLEAN

Buy More and More War Bonds Until the Day of Victory

CHAMPION SPARK PLUG COMPANY, TOLEDO 1, OHIO

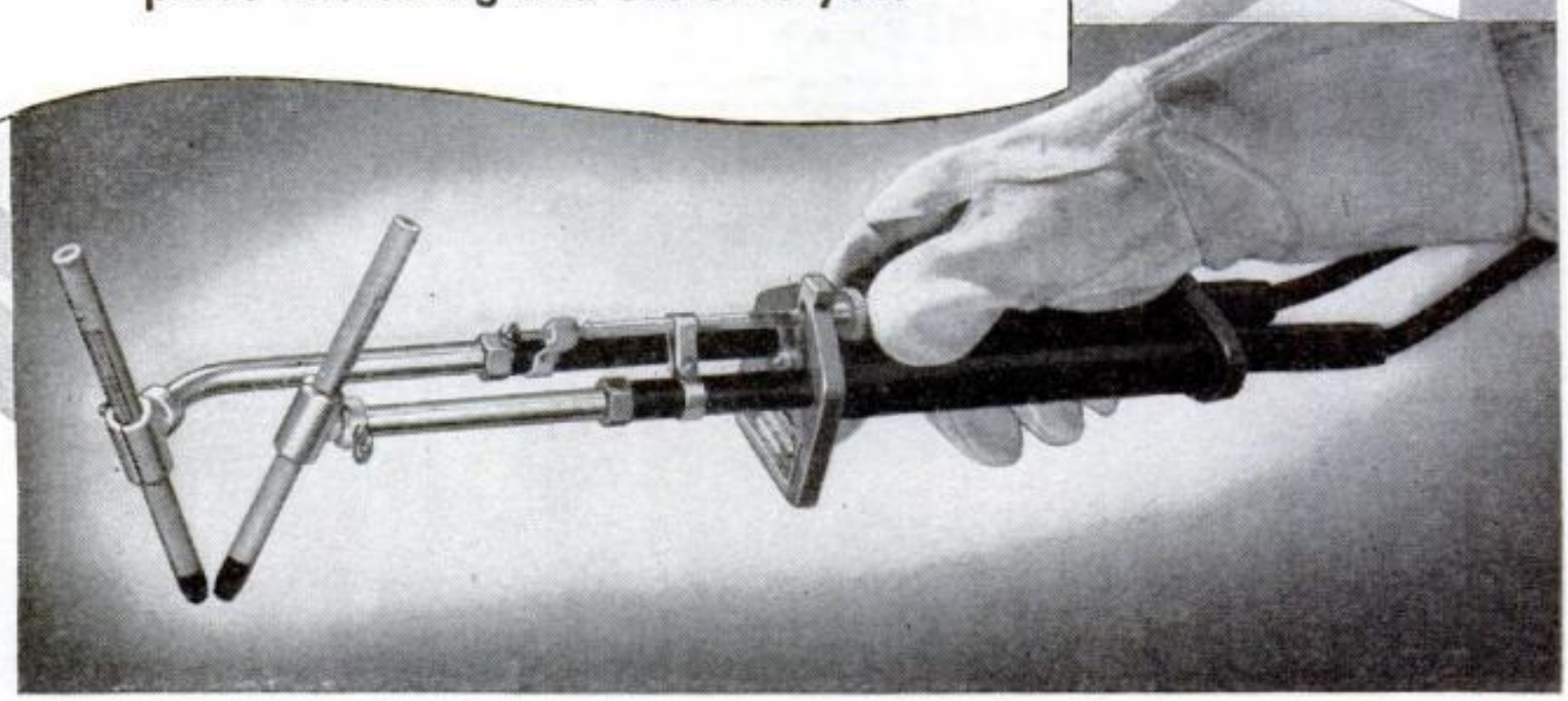
JANUARY, 1945

Buy War Savings Bonds and Stamps regularly.

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Ingenious New Technical Methods

Presented in the hope that they will prove interesting and useful to you.



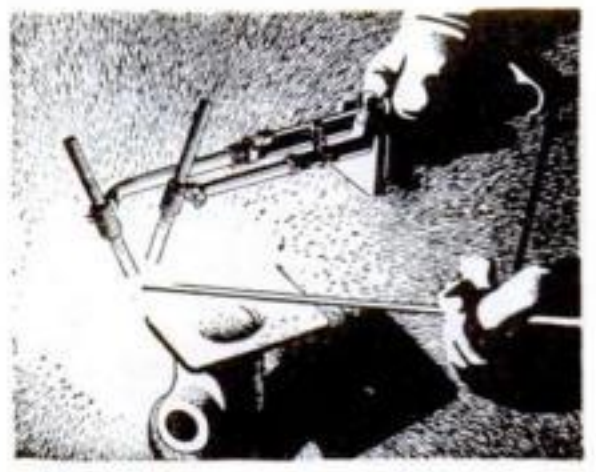
NEW 9000° ARC TORCH CAN BE USED FOR WELDING AND BRAZING ALL FERROUS AND NON-FERROUS METALS AND ALLOYS

Now an arc torch that makes it possible to do most jobs *electrically* that previously were thought possible only with gas. This attachment for arc welders provides an independent source of heat by means of two carbons. It is capable of producing intense heat, approximately 9000° F., over 2000° hotter than an oxyacetylene flame. Pure heat, no oxygen or gas to contaminate the weld. No pressure to force the molten metal away or blow holes in light sections.

Developed to capitalize to the fullest on the time-saving advantages of electric welding, the new Mid-States 9000° arc torch can be used with any AC or DC electric welder. It opens up new horizons of service in this field, never before possible with an electrically operated instrument.

New uses are being found every day for products that have been familiar to us for years. Wrigley's Spearmint Gum, always enjoyed for its chewing satisfaction, is now proving with the fighting men overseas many benefits which will be useful to you in peacetime. One of the big factors in mass production is the alertness and efficiency of the man on the job. The chewing of Wrigley's Spearmint will help keep you alert and wide-awake during those work periods that, while seemingly dull and monotonous, call for watchfulness in order to get perfection in the final assembly.

You can get complete information from Mid-States Equipment Co., 2429 Michigan Avenue, Chicago 16, Illinois



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For HEATING to Straighten or Bend, etc.

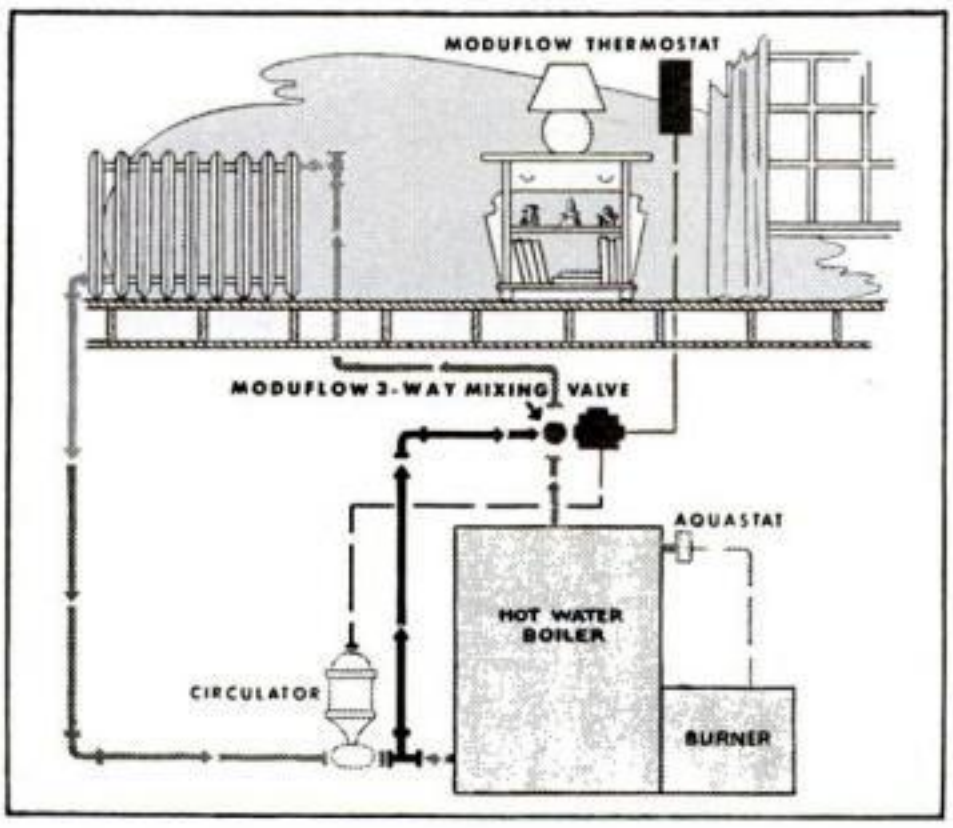
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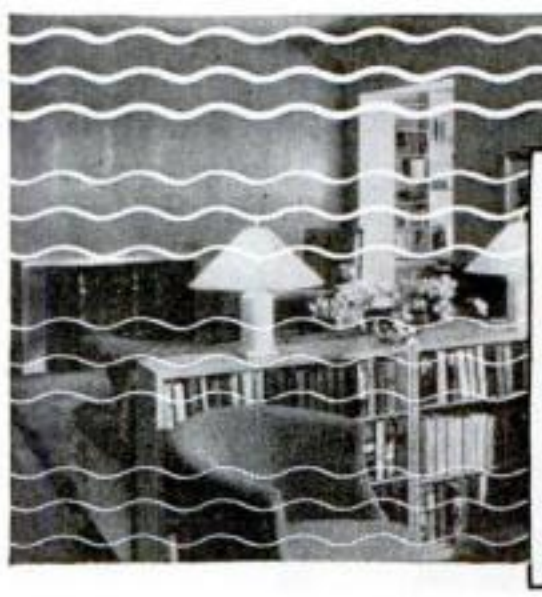
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Moduflow

HONEYWELL'S Amazing New Control System will *Revolutionize Home Heating*

NOW you can end the discomfort of ordinary "on and off" heating systems. No longer need you swelter, then freeze : : . For Minneapolis-Honeywell engineers have perfected a marvelous new system of heating controls. It is called MODUFLOW — heat *modulated* to just the right degree with a uniform, continuous *flow*. It is the exact opposite of the intermittent heat supply of conventional heating systems.





WITHOUT *Moduflow*

Heat is supplied intermittently, with periods of heat and no heat. Result—drafts, cold floors, hot ceilings, fuel wasted.



WITH *Moduflow*

Heat is evenly distributed and continuously supplied at the desired temperature. Result—24-hour, year-round comfort with fuel economy.

HERE'S HOW *Moduflow* WORKS

Moduflow is a simple, but ingenious, arrangement of controls that operates on an entirely new principle. It can be used with any type heating plant, hot water, warm air or steam, and with any kind of fuel. The diagram illustrates a hot water system. The solid black lines show the simple changes required. The hot water or steam is tempered at the boiler by means of a "by pass" line and mixing valve, to just the degree required by outside weather conditions. Heat is furnished *continuously* at the command of the modulating thermostat. Room temperatures vary only a fraction of a degree from high to low, and are uniform from floor to ceiling.

MODUFLOW IS NOW AVAILABLE for only a limited number of homes. Before you make plans to build or remodel, be sure to investigate Moduflow. Send for the illustrated Booklet: "Heating and Air Conditioning the Postwar Home." Just mail the coupon.

Keep them Winning—Buy MORE Bonds!

MINNEAPOLIS Honeywell

TEMPERATURE CONTROLS

Makers of the famous M-H Electronic Autopilot, used on AAF 4-engined bombers



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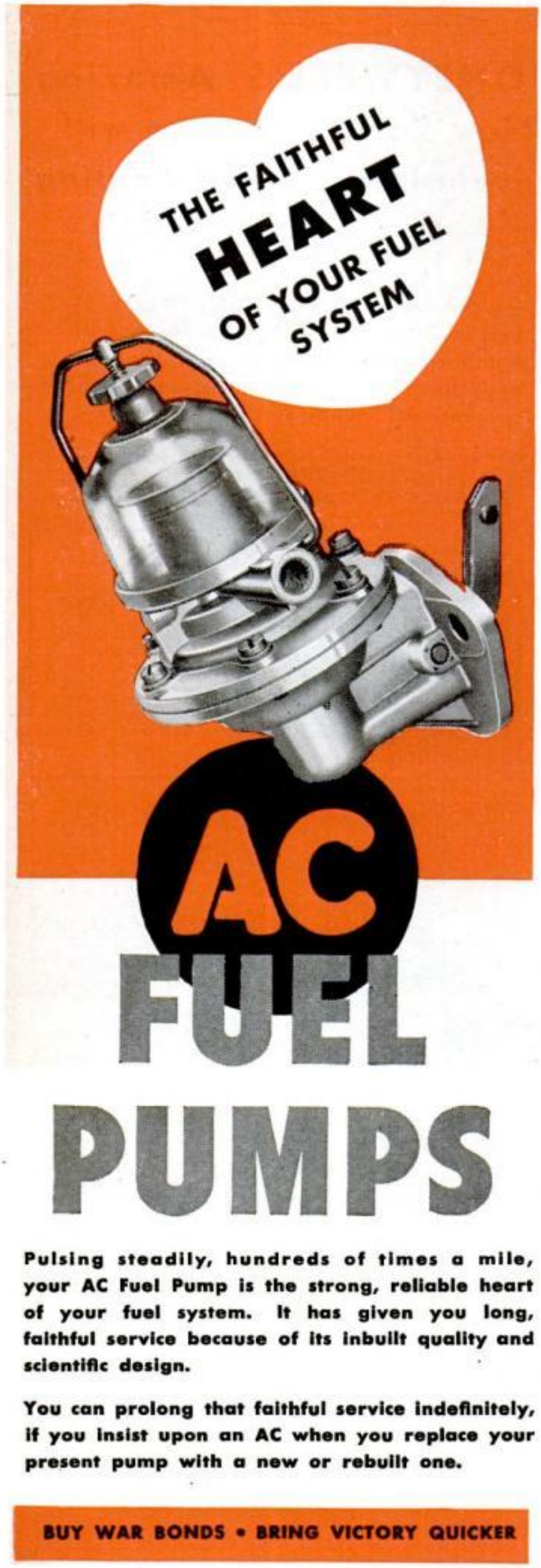
Please send my free copy of "Heating and Air Conditioning the Postwar Home"

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Death Flies at 50 Feet

(Continued from page 212)

came in to a target right on the deck—20 to 50 feet off the water—and stayed on the deck until the last possible second before pulling up to 200 feet to bomb.

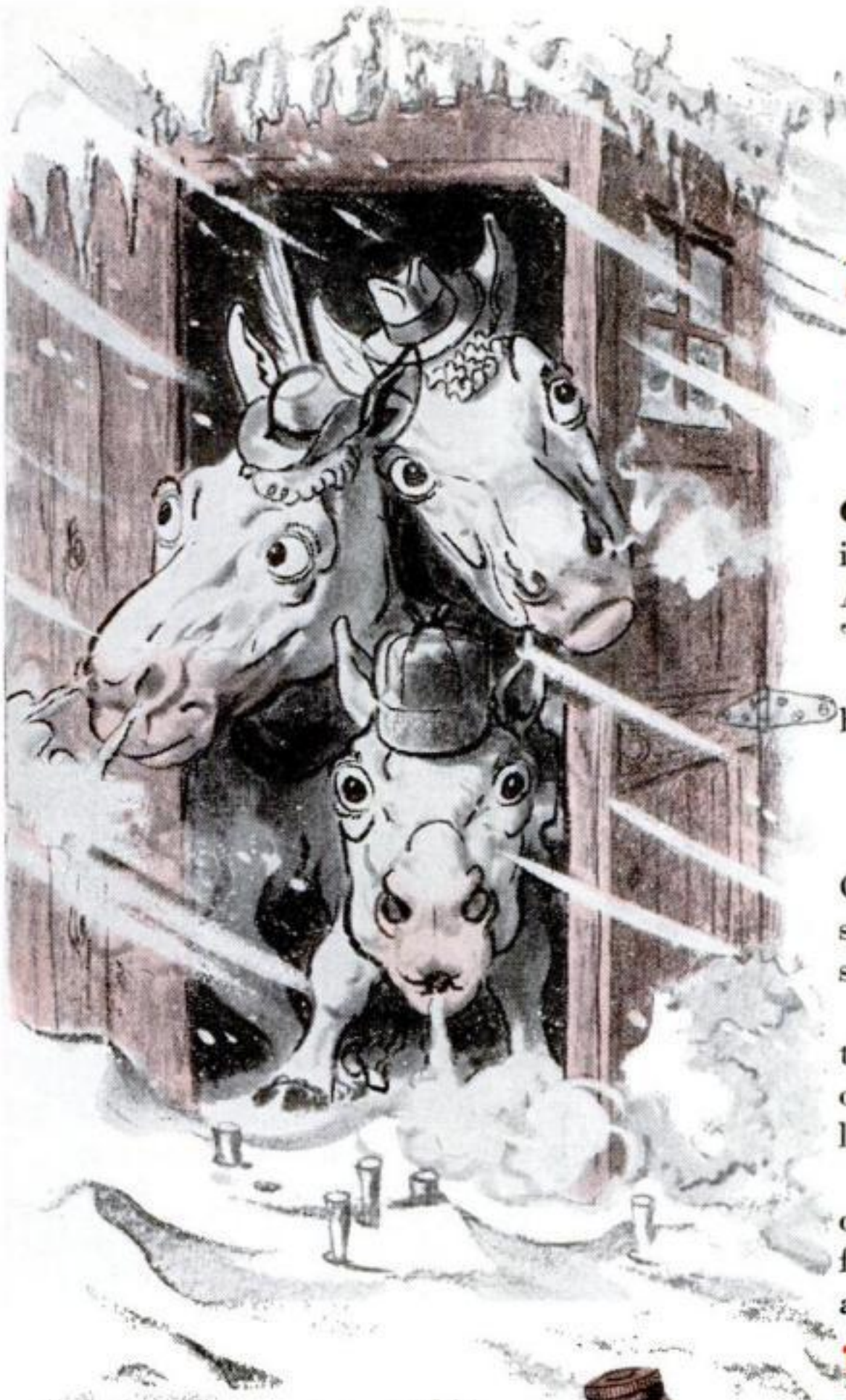
On some occasions, there was time for a second run before the enemy caught his breath. The Japs do not sleep by their guns, and, although they'd be firing on the second run, their guns would not yet be directly trained on the plane. Third runs were never made; by then the Japs *were* ready.

Of course, the planes were sometimes hit by flak. Engines were hit and planes were holed, but they always came back—and with the crew safe. Even with no time to train guns on a low-flying plane, the enemy pumps a curtain of fire straight up, and, flying through such a hail of bullets and explosive projectiles in your big target, you are bound to be hit. Lt. Joseph H. Jobe, USNR, of Goldendale, Wash., came back 750 miles from the Bonins to Saipan on three engines one night with his bow and belly turrets shot away and a fire in his waist hatch from rupturing ammunition and exploding oxygen bottles, and landed safely in the rain on an unlighted field despite a blown tire. And Lt. Comdr. John F. Bundy, USN, of Sioux City, Iowa, brought his riddled plane from the Kazans safely back to Saipan after an engine was shot out at 50 feet altitude on a night-bombing run across Iwo Jima. But flak in such a surprise attack is never the terror it is for bombers at altitude when the enemy can detect their approach from afar and merely wait for the range to close.

Antiaircraft fire from ships was more accurate and intense than that from shore bases, the Japs needing so desperately to preserve their ships and with them the thin line of supply to what remains of their far-flung empire. But the aggressiveness encouraged in the squadron, and the pilots' confidence in their own low-level tactics, led them in against the most overpowering naval antiaircraft fire. Commander Miller entered Truk lagoon nine times alone at night searching for shipping, sinking a destroyer and a 10,000-ton tanker on separate trips, and one night kicking a light cruiser around 90 degrees and laying it on its side, its keel exposed. Lieutenant Jobe blew the stern off a destroyer at Chichi Jima. Lt. Comdr. George L. Hicks, USNR, of Three Rivers, Calif., executive officer of the squadron, jumped an 11-ship convoy between Guam and Truk—away off the beaten path

(Continued on page 218)

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WINTER IS ROUGH ON HORSEPOWER

● Outside, it's bitter cold. The service station phone never stops ringing. All over town, people are wailing, "My car won't start!"

Too bad. This trouble could have been avoided . . . with Casite.

Casite Guarantees Summer Starting in Winter Weather or Double-Your-Money-Back

Casite keeps oil from congealing . . . speeds oil flow. Result: a fast, sure start, even in coldest weather.

Casite cleans out motors, keeps them clean. And everyone knows a clean motor runs better and lasts longer.

Casite is sold by service stations, car dealers and garages everywhere, for only 65¢ a pint. Get Casite today and start *every* day!

THE CASITE CORPORATION
HASTINGS, MICHIGAN

Guarantee

We guarantee that any motor capable of being started in a warm room will start in the coldest weather when Casite is added to the crankcase . . . Add Casite according to instructions. If your car fails to start, you get double your money back by filling out guarantee certificate and mailing it to The Casite Corporation, Hastings, Michigan. Maximum refund is $1.30 per pint, which is twice the nationally advertised price of Casite.



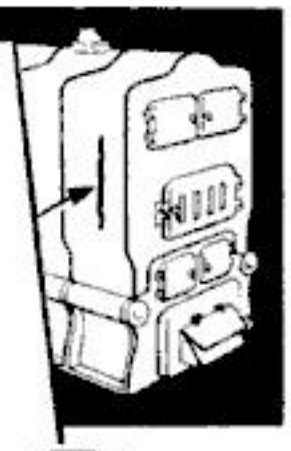
CĀSITE

CLEANS OUT MOTORS
KEEPS MOTORS CLEAN

IT'S A PRIVILEGE TO BUY WAR BONDS

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STOP Wasteful Leaks in your Heating System

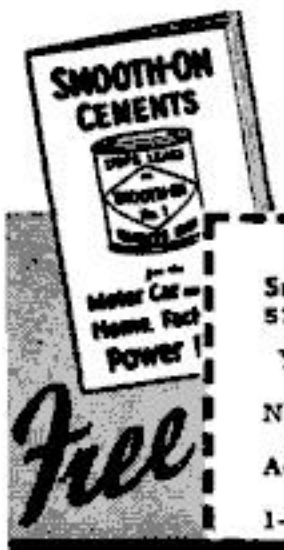




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Do it with SMOOTH-ON

Death Flies at 50 Feet

(Continued from page 216)

—at night shortly before the Marinas invasion. There were three large merchant ships, seven gunboats, and a destroyer. Boring in at masthead height through a deadly screen of protective AA fire, he blew up a precious 7,000-ton merchant ship with his bombs and set the other two afire. Before heading for base he managed to damage three of the gunboats and silence the AA fire on the destroyer. The next night in the same area Lt. Thomas R. Wheaton, USNR, of Independence, Mo., took on a nine-ship convoy single-handed, sinking a gunboat, crippling a second, and damaging a third. Lt. William B. Bridgeman, USNR, of Pasadena, Calif., nearly blew himself out of the air when he laid his bombs across the deck of a medium-sized merchant ship off Ponape. Instead of getting the usual "lift" from the bombs bursting behind, Lieutenant Bridgeman's plane was violently catapaulted forward and nearly somersaulted. Flames towered high above the plane. He had hit an ammunition ship.

Enemy planes were not often willing to mix it up with the low-flying Liberators, although Japanese pilots varied greatly in degree of aggressiveness. Occasionally several Zekes and Tonys made concerted attacks, but the boys simply sat down on the water and jinked toward home. No squadron plane was damaged by enemy planes, but several Nips who came in too close were knocked down or sent smoking back to base. Lt. Comdr. William Janeshek, USN, of Port Washington, Wis., shot down a jap torpedo bomber, Kate, one afternoon ten miles off Truk in an encounter lasting a minute and a half. On two occasions pilots deliberately attacked enemy fighters. Lt. Oden E. Sheppard, USNR, of Bozeman, Mont., jumped a new twin-engine fighter and reconnaissance plane, Irving, and sent it limping home, and Lt. Harold E. Belew, USNR, of Fresno, Calif., boldly attacked a second one a few days later.

Bombing Squadron 109 came back to the States in September for reorganization and rest, with the best record of destruction against the enemy of any land-based Navy search unit in the Pacific. Soon they will head back for another tour of combat duty, and they will continue to do just what they did before—fly day and night and far in excess of their assigned missions hunting for the enemy. They will come in on him singly at treetop and masthead height, where they can see what they hit and what happens to it. They like it low.

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ARMY AIR FORCES PHOTO

IN A FAR-OFF U.S. Army Air Forces base, deep in the Pacific, a telegrapher rattles his key...

"need P-61's number to X"..."need six complete fighter plane wing assemblies classification Y"..."need——"

A very short time later, a bell rings on a machine in a building at Wright Field, near Dayton, Ohio. Softly clacking keys reproduce the appeal on a cablegram form.

At once a vast and highly organized system is set in motion. The deadly P-61's—Black Widows—must go by ship. But no time is lost by the Air Technical Service Command. Westward they go by sea, in knockdown form.

Off go the wing assemblies by cargo plane. And soon, six fighter planes will roar back into combat against the Japs.

That building near Dayton houses the headquarters of the Air Technical Service Command, which supplies and maintains all equipment of the Army Air Forces.

Its *Supply Division* is the heart of the ATSC. Hundreds of thousands of different items are handled—from bombers to jungle kits.

The *Maintenance Division* keeps Army Air Forces airplanes in combat condition. All told, the ATSC may repair as many as 25,000 airplanes in a single month.

The *Personnel Division* of ATSC supplies and trains the 300,000 civilian workers who make this command the largest industrial employer in the world.

The finest tribute to these men and women and the uniformed members of the ATSC is the proud record of our Army Air Forces in combat.

WAR BONDS—TO HAVE AND TO HOLD!

SPERRY

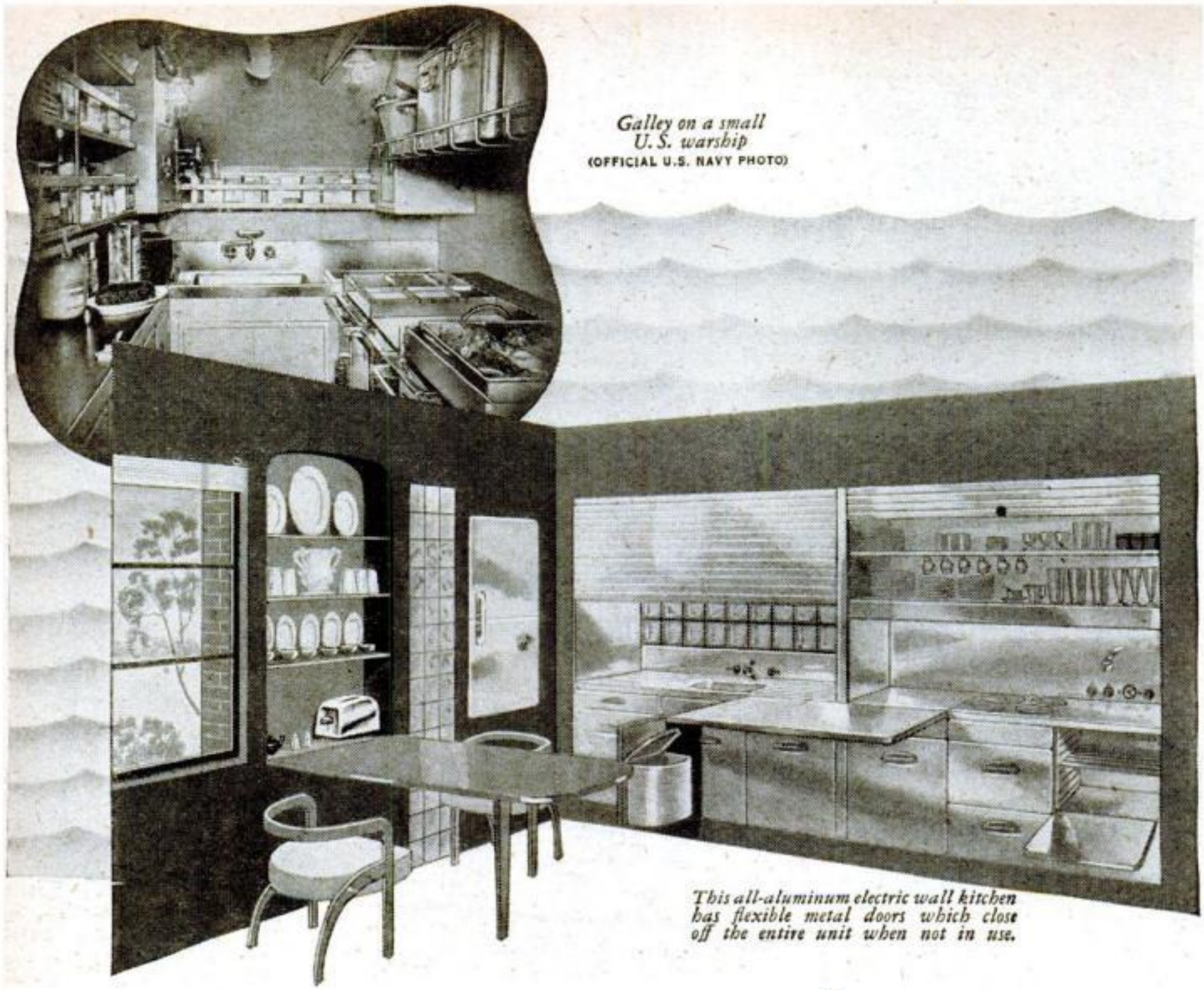
CORPORATION

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Developed and manufactured by the following divisions, Sperry precision instruments and controls serve the Armed Forces on land, at sea, and in the air...

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Galley on a small U. S. warship
(OFFICIAL U.S. NAVY PHOTO)

This all-aluminum electric wall kitchen has flexible metal doors which close off the entire unit when not in use.

Everything Shipshape

Smart, compact and shipshape as the galley of a modern warship is the inviting, space-saving pre-fabricated kitchen unit for small dwellings, portrayed above. Defoe presents this design as one of many that postwar America may expect from the pre-fabricated housing industry. The goal of this industry will be to improve living standards and provide widespread employment. Today, Defoe's only job is to build dependable fighting ships for the Navy. But after Victory, the experience, skill and ability required by this exacting work will be devoted to building quality products for peacetime America. Our postwar work will reflect the same heart and pride we put into our present crucial job.

DEFOE SHIPBUILDING COMPANY, BAY CITY, MICHIGAN

Four White Star Renewal Citations now decorate the Navy "E" Award won by Defoe workers.

BACK THE ATTACK —BUY WAR BONDS

Defoe

SHIPS FOR VICTORY . SERVANTS FOR PEACE

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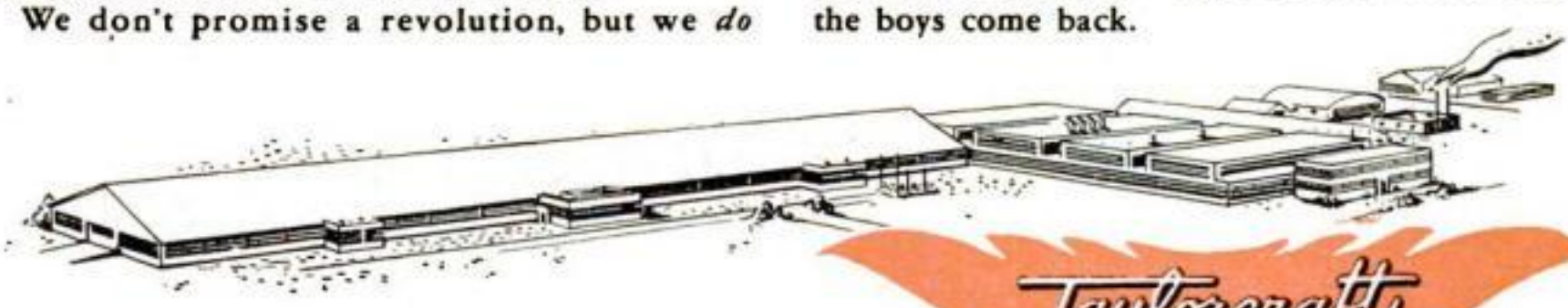
TODAY'S TAYLORCRAFT is easy to fly . . . any pilot knows that. But wait till you see the *new* 'Craft of tomorrow.

We've set our sights on a plane that will be still easier to fly . . . a faster, more luxurious ship with *built-in stability* . . . a plane that will give you more flying satisfaction every mile of the way.

We don't promise a revolution, but we *do* promise a far finer plane than the fine ones we've built in the past.

We *do* promise a 'Craft that will be priced low enough to be easily within reach of the flying public . . . *a plane which costs less to buy and less to operate.*

Keep your eye on Taylorcraft. "The ship with the built-in tailwind" will be out in front when the boys come back.

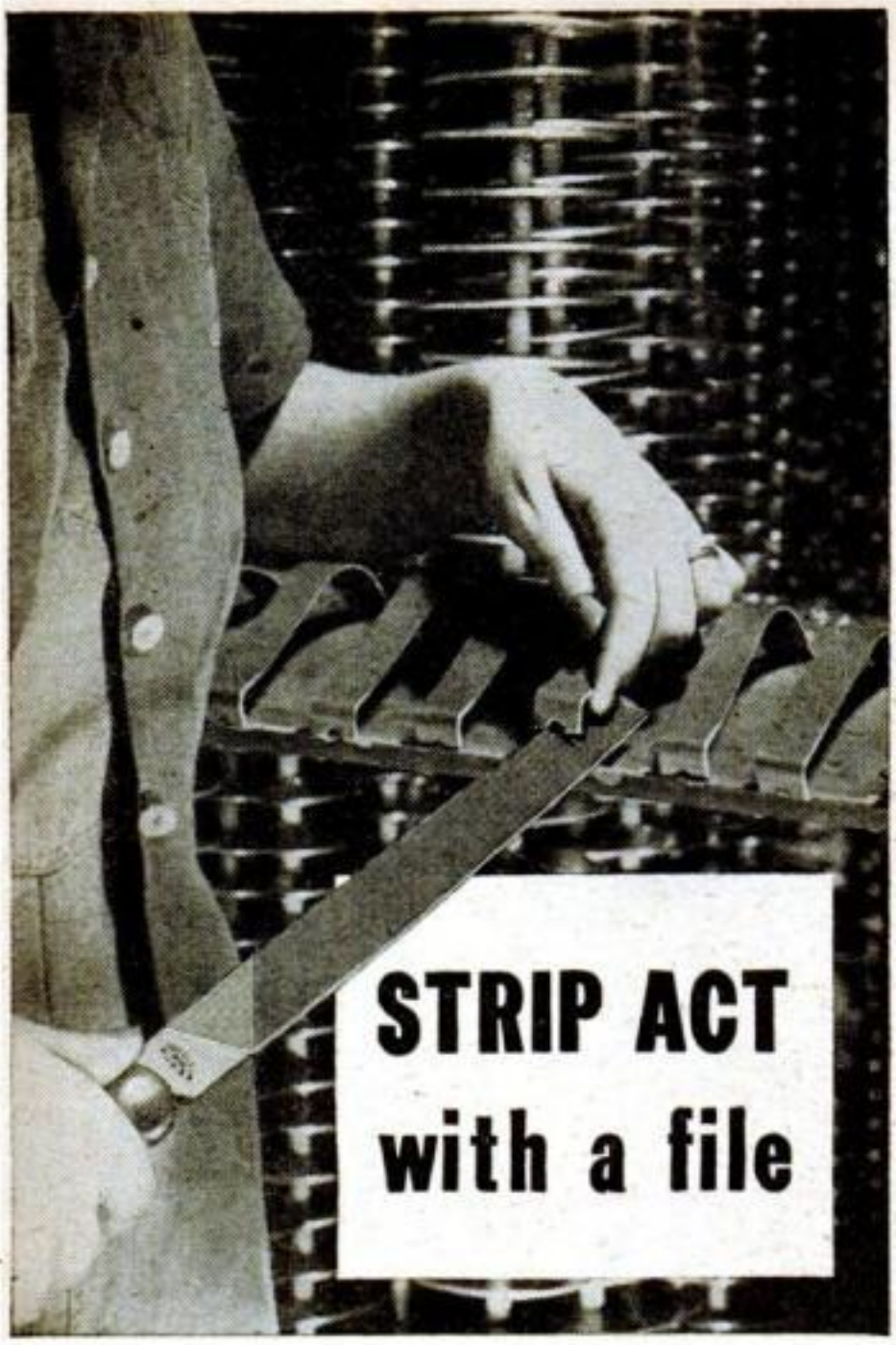


Taylorcraft

World's Largest Builders of Side-by-Side Airplanes

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YES, industry has its "strip acts." The one illustrated here helps to make airplane and other vital war-product parts strong and dependable.

It is part of a plating operation which provides aluminum alloys with a "diamond-hard" finish impervious to rust and tremendously resistant to surface wear. So tenacious is the anodizing solution that *only a file* can strip the residue from the racks which hold the parts while being dipped.

Stainless steel, chromium and other modern metals and alloys issue an unending challenge to shop tools. Nicholson manufacture and research are constantly meeting it where files are concerned. File steels, tooth structure, hardening—all have made such progress that Nicholson Files, in thousands of kinds, cuts and sizes, are recognized by mechanics throughout the world as the very highest in quality and modern design.

FREE BOOK, *"FILE FILOSOPHY"*— an intensely interesting and informative handbook (48 pages) for production and purchasing heads, foremen, key mechanics, "hobbyists."

NICHOLSON FILE CO., 19 Acorn St., Providence 1, R. I., U. S. A.
(Also Canadian Plant, Port Hope, Ont.)

NICHOLSON FILES *FOR EVERY PURPOSE* NICHOLSON U.S.A. MADE IN U.S.A.

I Cruised on the Iowa

(Continued from page 82)

sister ships now in service, and two others near completion.

Next day we steamed seaward. At a safe distance from anything that might get hit, the 16-inchers opened up on the target—a vertical square affair on a raft, towed by a tugboat at the end of a generous 1,000-foot cable. Though I had no telescope powerful enough to observe results closely, I doubt very much if that target will ever be used again.

Antiaircraft guns seemed to bristle from every vantage point of the *Iowa*. They included 20-mm. (about 0.8-inch) Oerlikon guns for close range; 40-mm. (about 1.6 inch) Bofors guns for medium range; and the dual-purpose five-inchers, usable against both planes and surface craft.

For targets, Navy men on the deck inflated black balloons with buoyant gas from cylinders, and sent them aloft—either singly or in clusters. To us, it seemed that each group of guns was being ordered to hold its fire until the balloons almost drifted out of its range. Then the barrels of the Oerlikons began chattering, the Bofors guns pounded, and the five-inchers opened up with cracks that rivaled even the big rifles. We laughed to find ourselves cheering on the gunners, and yelling approval as one balloon after another burst in the sky. Seeking official rating of the score, we were gravely informed that it was "4.0"—which sounded precise enough until we learned that 4.0 is top grade for exam papers, and therefore Navy slang for anything excellent.

We wanted to get into one of those big turtle-domed 16-inch turrets and see what the inside looked like. A friendly gunnery officer took our part. One way, he explained, led through the bowels of the ship. The nearer approach was to crawl on deck right under the rear overhang of the turret, and scramble up through a hatch.

From the turret officer's booth, a few steps forward took us to the guns themselves, mounted in deep individual pits. For loading, the gun is aimed slightly upward. Then, as the crew showed us, separate dumb-waiters bring up a 2,400-pound shell and the standard powder charge. In turn these are rammed home by one of the most curious mechanisms imaginable—a power-operated coil of hinged metal blocks, forming a rigid shaft as it unwinds.

In modern practice, a central control station high enough for good visibility serves as the nerve center for all turrets. In this

(Continued on page 226)

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When it's an EXIDE *... you start*



Good merchandise and good dealers go hand in hand. It pays to buy products and services from the man who offers **KNOWN** brands of high quality.

THE ELECTRIC STORAGE BATTERY COMPANY
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Exide Batteries of Canada, Limited, Toronto

BUY TO LAST

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What happens when a fur coat catches fire?

It *could* be a mighty expensive fire —in a storage vault full of priceless furs. But when the vault is protected by a Kidde Extinguishing System — as many are — fire is detected *instantly*... *automatically* smothered by carbon dioxide gas that kills the blaze in seconds. Clean, dry gas leaves furs unharmed.





Alligators don't fear fire — Big U. S. amphibious fighters carry heavy wallop against fire with Kidde built-in extinguishing systems to protect crew and vehicle.

On flaming steaks use Kidde extinguisher. Dry, clean, carbon dioxide doesn't even affect taste. Restaurants use this extinguishing equipment.



Gases-under-pressure, harnessed by Walter Kidde & Company, are serving our fighting men in many ingenious ways. After the war they'll serve you. Look for them!

Walter Kidde & Co., Inc., 140 Cedar St., N. Y. 6, N. Y.

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There's been a big change



★ Imagine going places in a horse-drawn hack, when the tempo of the times demands a modern taxi!

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More rollers, more capacity. More rollers, longer life. More rollers, increased rigidity. The Tyson "All-Rolls" Bearing is hailed as the sturdiest and longest-lived bearing ever built for heavy-duty service.

The big name in bearings today is ...**TYSON!**

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COUNT THE ROLLS · THE ROLLS COUNT

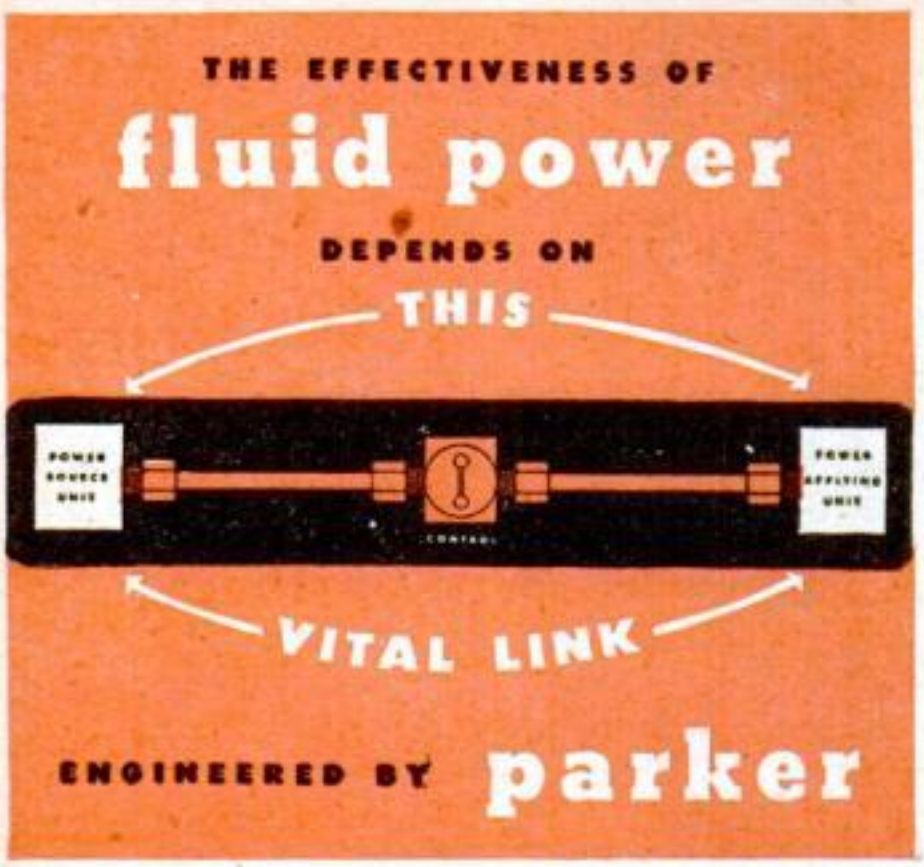


Tyson

TODAY'S HEAVY-DUTY BEARING

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The Circuit carries fluid power around corners and into tight places —wherever you want it to go. It must be leakproof, vibration-proof, able to stand high pressures and resist corrosion.

Engineering fluid power circuits is a Parker job. Years of experience have showed us how to design them, how to build the necessary valves and fittings and how to plan sure-working installations.



THE PARKER COUPLING is the key to the vital link, engineered and designed by Parker—protected against leakage and vibration, precision-made, quick to install, quick to service.

Ask a Parker Fluid Power Engineer how you can use this modern form of power on your machines of today or tomorrow. No obligation—just write to The Parker Appliance Company, 17325 Euclid Ave., Cleveland 12, Ohio.

THE PARKER APPLIANCE COMPANY
CLEVELAND • LOS ANGELES
FLUID POWER ENGINEERING

I Cruised on the Iowa

(Continued from page 222)

system, called director firing, the gunnery officer presses a trigger in a pistol-like grip to fire a whole broadside at once.

Near the base of each 16-incher, we noticed, the sailors had painted on such feminine names as "Mary" and "Agnes." "Millie" apparently had fallen from favor, for her name was all but erased with a stroke of a paint brush.

Members of the gun crew told us they never wore ear cotton, and that all they heard of a 16-inch gun's blast within the heavy turret was a muffled thud. And, in fact, we found it perfectly possible to nap in our cabin during a major bombardment outside, after we had seen and heard enough on deck to satisfy us.

Did you know that battleships have more periscopes than submarines? We found the heavily armored tower stations replete with them—a natural state of affairs, come to think of it, when the only other way of looking outside is through narrow eye slits in the thick walls. Scales on the periscope mountings, in addition, give the exact bearing of objects picked up by the rotating instruments.

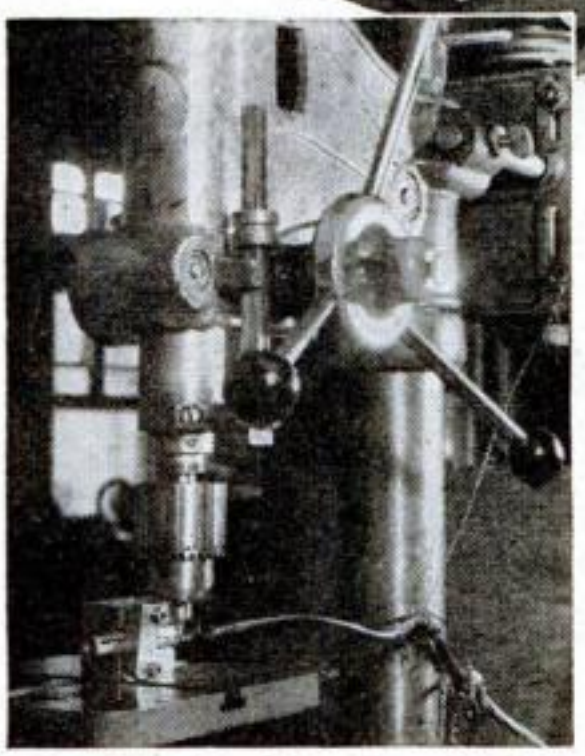
In the navigating station, we saw how the great ship keeps on her course. Surrounded by compasses and other indicating dials, the helmsman grasps no large-spoked steering wheel such as an old seafarer's imagination might conjure up. Instead, he merely turns a solid disk less than two feet in diameter. Powerful steering engines, magnifying the power of his hands innumerable times, swing the twin rudders that guide the ship. The reason for using two rudders, by the way, is simply that a single one of sufficient area to steer the enormous vessel would be too large.

I had wondered whether Navy men preserved the old "no-whistling" tradition on shipboard. They do. There was no superstition about it, several of them explained to me, but simply the danger of confusing a sailor's careless whistle with the shrill note of the bo'sun's pipe.

This is the attention-calling signal that precedes important announcements over the *Iowa's* public-address system—issuing orders such as "prepare to darken ship," paging officers, transmitting customary bugle calls, and announcing news of general interest. To me its most exciting summons, often repeated during training exercises, was: "General quarters—man your battle stations!" It was a command to be heard in real earnest during more recent days.—ALDEN P. ARMAGNAC.

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Atlas No. 63 drill press, in Triex plant, used with No. W68 Universal Vise in a vertical milling operation. Thousands of pieces have been made with this jig.

Succes WITH Atlas.



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Starting five years ago with three machines and lots of ambition, Mr. A. L. Moss and his unusual cohorts of The Triex Machine Tool Company of New York City have made an amazing precision production record. They turn out gauges within 1/10 of .001. Work in quantities from two pieces to 60,000, all within extremely fine tolerances — on over 30 Atlas lathes, drill presses, milling machines, and shapers.

There are few machinists in the shop. Most of the men come from the professions — musicians, artists, accountants, teachers — men who a few years ago didn't know the difference between a lathe and a micrometer but today work to a tolerance of half a thousandth.

The success story of Triex — typical of hundreds founded on Atlas equipment — is a hopeful sign to men of vision and ability who plan to build businesses of their own after the war. If you have such ambitions, you can build soundly on a foundation of modern Atlas tools.

SEND FOR LATEST ATLAS CATALOGS

Although all Atlas production is on high priority and will be until war needs are filled, it is not too early to start making your postwar equipment plans. Send for latest catalogs. Tell us which tools — lathes, drill presses, milling machines, shapers — interest you most.

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NEW ATLAS PATTERN SERVICE FOR WOOD CRAFTSMEN. See ad on page 254

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MIDWEST RADIO CORPORATION BEGINS ITS

Silver Anniversary Year

This year of 1945 marks the 25th Anniversary of the Midwest Radio Corporation. It has been a quarter-century of pioneering, of progress, of achievement, of leadership in the field of radio. Very few radio manufacturers can match the unbroken record of continuous manufacture and of faithful adherence to high quality standards which MIDWEST RADIO has established and maintained for the past twenty-five years.

Since its establishment in 1920, Midwest Radio Corporation has figured prominently in the pioneering of many outstanding radio developments. Among them: Single dial, 3-gang condenser battery sets . . . all electric radios . . . superheterodyne . . . screen grid . . . amplified and- resonant AVC . . . dual speakers . . . 2400 meters band . . . shielded switching . . . noise-reducing antenna system . . . push button tuning . . . ceramic porcelain insulation . . . reinforced capacitors . . . pre-balanced coil assembly . . . accousti-sonic louvres . . . 9-Band dial . . . and others too many to mention.

Today—although still engaged exclusively in the production of electronic and radio instruments for our Armed Forces—Midwest is planning new and finer radios for the post-war period. And when the new MIDWEST RADIOS are again available you may be sure that you can once again save up to 50% by buying on the famous MIDWEST factory-to-you plan.



MIDWEST RADIO CORPORATION

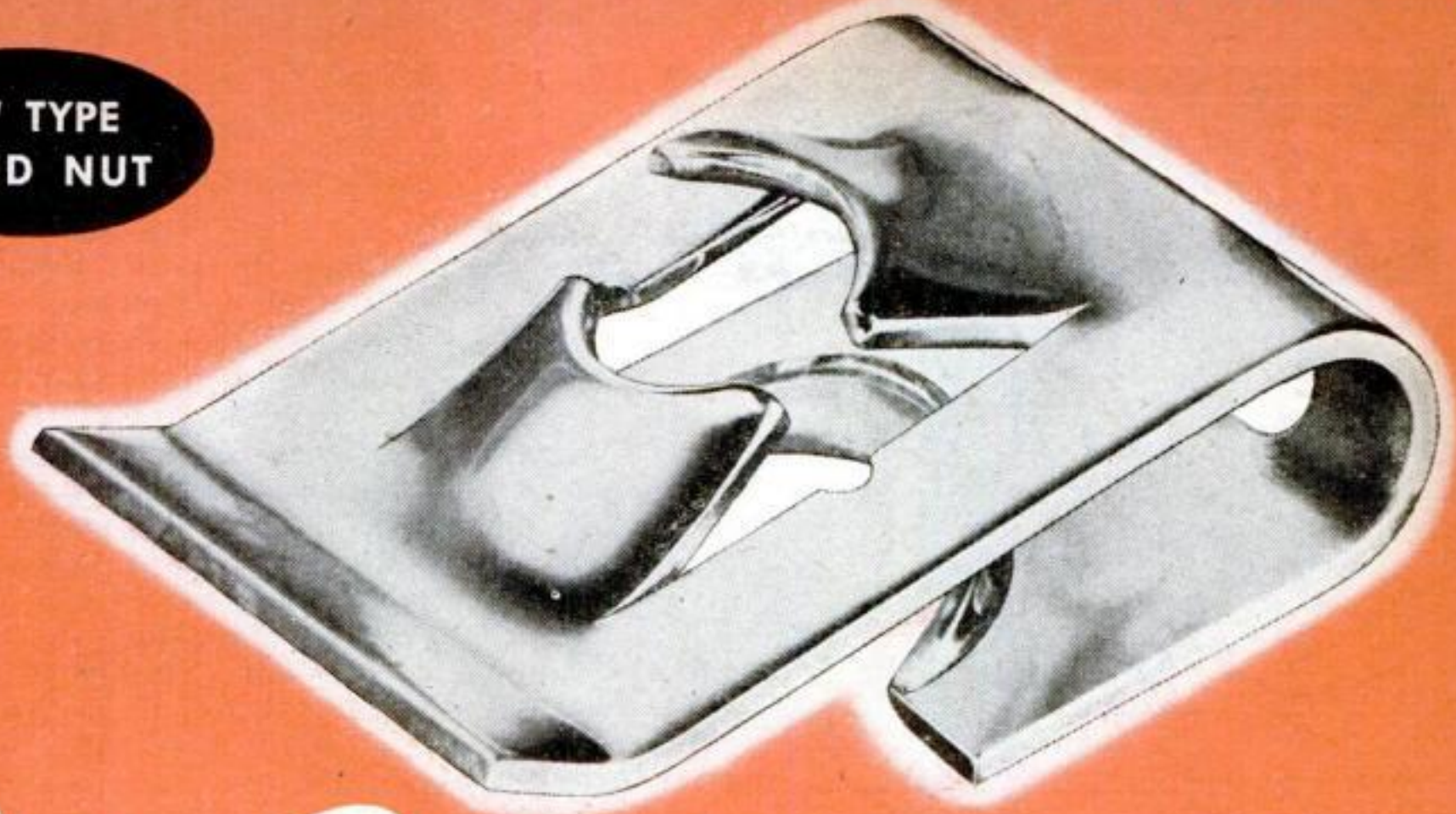
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"J" TYPE SPEED NUT



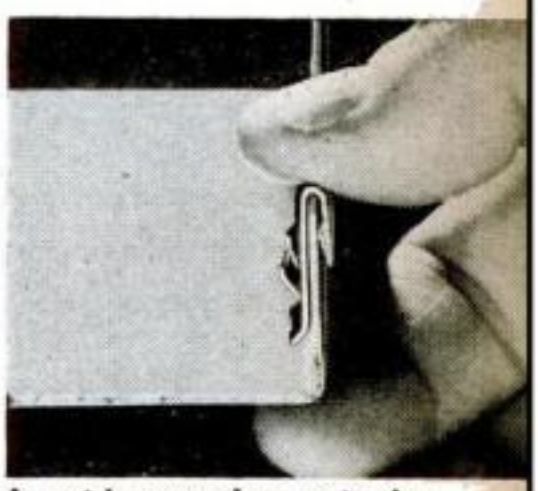
Self-Retaining

for

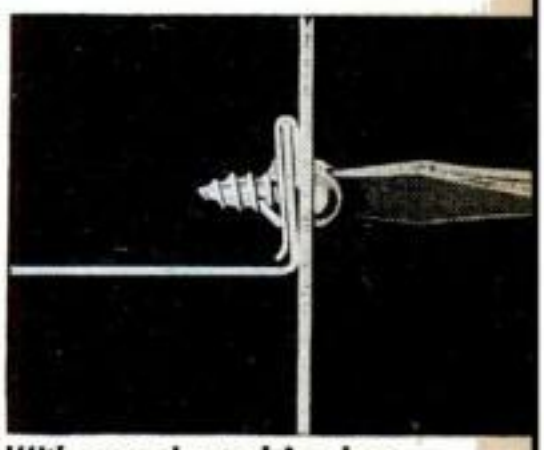
BLIND LOCATION ASSEMBLY



Positioning "J" nut over hole in flange.



As nut is pressed on, extrusion on lower leg snaps into hole.



With second panel in place, screw is driven. Access to opposite side unnecessary.

● Another exclusive SPEED NUT design to simplify and speed up blind location assembly. The "J" nut is attached by hand and *holds itself in place*, thus eliminating the necessity of welding, riveting, or staking ordinary fasteners.

These spring steel SPEED NUTS are pressed over holes along edge of panels or flanges. An extrusion in lower leg of "J" nut *snaps* into hole to retain nut in perfect register. By increasing diameter of hole, any degree of "float" may be obtained, to compensate for misalignment.

The sturdy arched prongs of the "J" nut possess surprising holding power. They eliminate vibration loosening by *absorbing vibration*, yet are sufficiently resilient to prevent damage to enamel, plastic or glass.

"J" type SPEED NUTS will improve your postwar products, speed up assembly, and reduce costs. Send in your assembly details today and we'll gladly rush samples.



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of Spring-Tension Lock is
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Speed Nuts ★ PATENTED

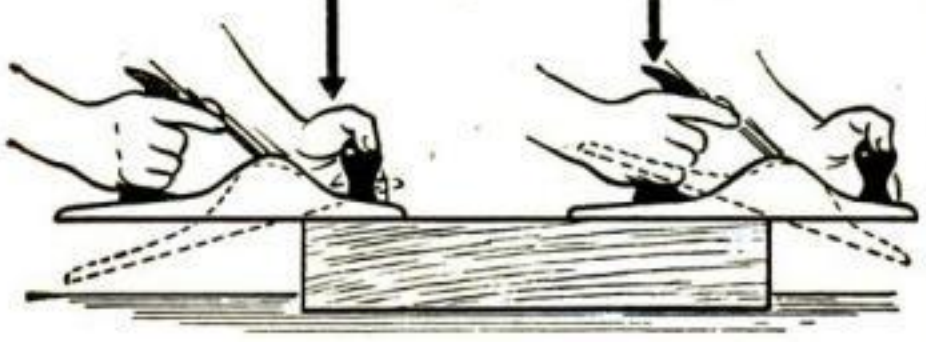
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FASTEST THING IN FASTENINGS

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Tool Tips by STANLEY

HAND PLANING

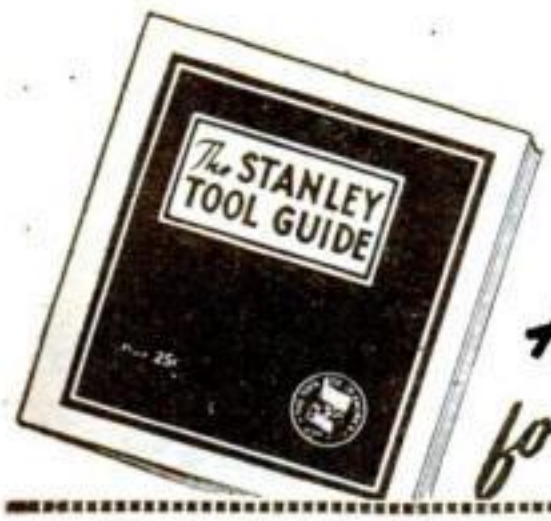


To cut a long, straight edge or surface, push the plane *with the grain* – in the uphill direction of the fibres. *Keep the plane straight* by pressing down on the knob at beginning of stroke and on handle at end of stroke.

It is easier to plane a long straight edge with a long plane than a short one. A long plane bridges the low parts and does not cut them till the high spots are removed.

DOZENS OF PROVED METHODS ARE COVERED IN THE STANLEY TOOL GUIDE

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You Can See Blast

(Continued from page 95)

from the preceding spark, the displacement being visible through an eyepiece.

To deal with acoustic conditions in the design of a building, a model may be made of the hall or room in question, often in plaster, and a photographic plate placed at one side. Opposite are the necessary sparking points and lenses. By recording the amount of light displacement, it is not difficult to calculate the results which may be expected in the actual building.

Human ears respond readily to a relatively narrow band of frequencies (approximately 20 to 7,000 per second). Yet the average ear often can hear a telephone diaphragm move less than one millionth of one millionth of an inch. Sensitivity cannot be reduced and we cannot become accustomed to noise. All we can do is to train our minds to disregard it. When some workers, such as those employed in boiler shops, speak of hearing better in noise, it usually means that their ears are so damaged that they need some external stimulus.

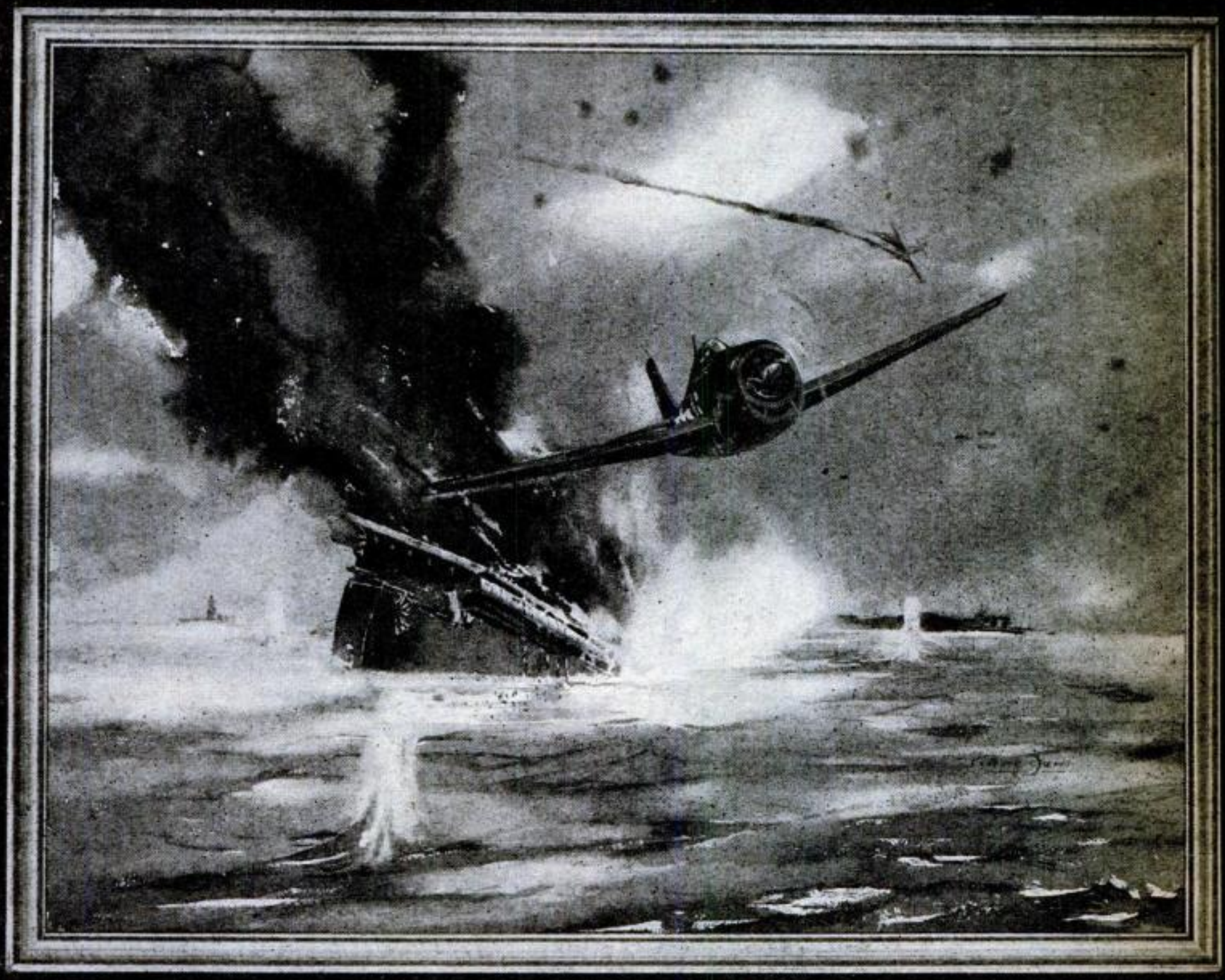
Sound can be reflected, it can be apparently "bent," and it heats the air through which it passes. Both the reflection and heating effects have been used for gun ranging. A sound mirror is very useful in making motion pictures, for it enables the voices to be collected. Similar reflectors are used to test for echo spots on walls or roofing by "firing" noise in various directions and locating the point where the echo occurs with a beam of light along the axis of the mirror.

The so-called refraction of sound often can be observed by listening carefully to a moving source such as a motorcycle. On a hot day, and if the road is smooth, the sound increases in volume as the motorcycle approaches the observer. The noise dies away as the exhaust recedes, and then will suddenly appear to become louder for a few moments. This is due to the reflection of sound downward toward the observer by the layers of hot air rising from the ground. This phenomenon represents a species of opposite effect from that of seeing blast.

The speed of sound, 1,100 feet per second in air, is far higher through solids. Gunfire often can be heard twice, first by earth and then by air.

Let us hope that, with our knowledge of sound, we may soon learn that the opportunity for seeing blast is something which should be confined to more useful explosions than those under which so-called civilization now suffers.

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U. S. Navy's Grumman Hellcat Completes a Mission

Grumman

AIRCRAFT ENGINEERING CORPORATION, Bethpage, L. I., N. Y.

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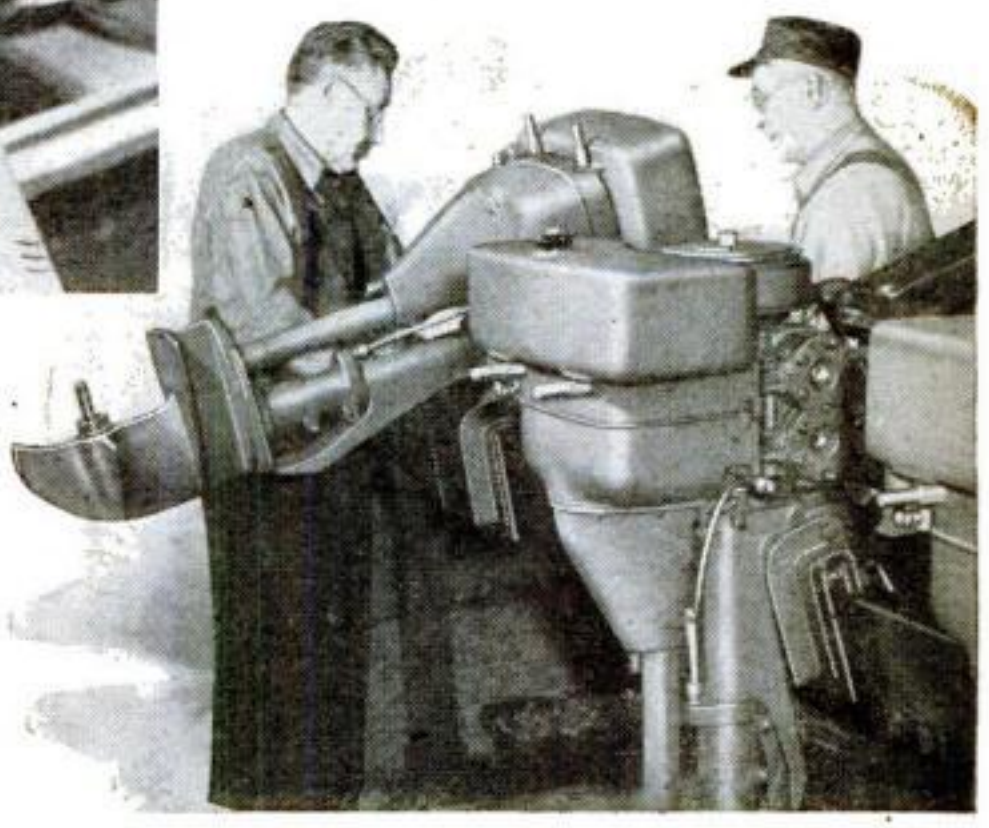
"You learn a lot about outboards ...in 35 years"

Canny old-timers know it's a fact. Owning motors, being shipmates with them, keenly comparing all types and makes . . . a fellow sure learns a lot about outboards in 35 years!

It's equally true of a manufacturer — with knowledge multiplied by engineering, building and testing hundreds of thousands of motors through this span of years. The result is *know-how* . . . a matchless "all-star feature" that reflects in every phase of operation . . . constantly rewarding the owner with extra dividends of fine performance . . . without a nickel of added cost!

The great Storm Boat Motors that serve on every fighting front are the product of 35 years of Evinrude *know-how*. When peacetime motors can again be built, this same *know-how* will be a priceless part of every motor that carries the Evinrude name.

EVINRUDE MOTORS, *Milwaukee 9, Wis.*



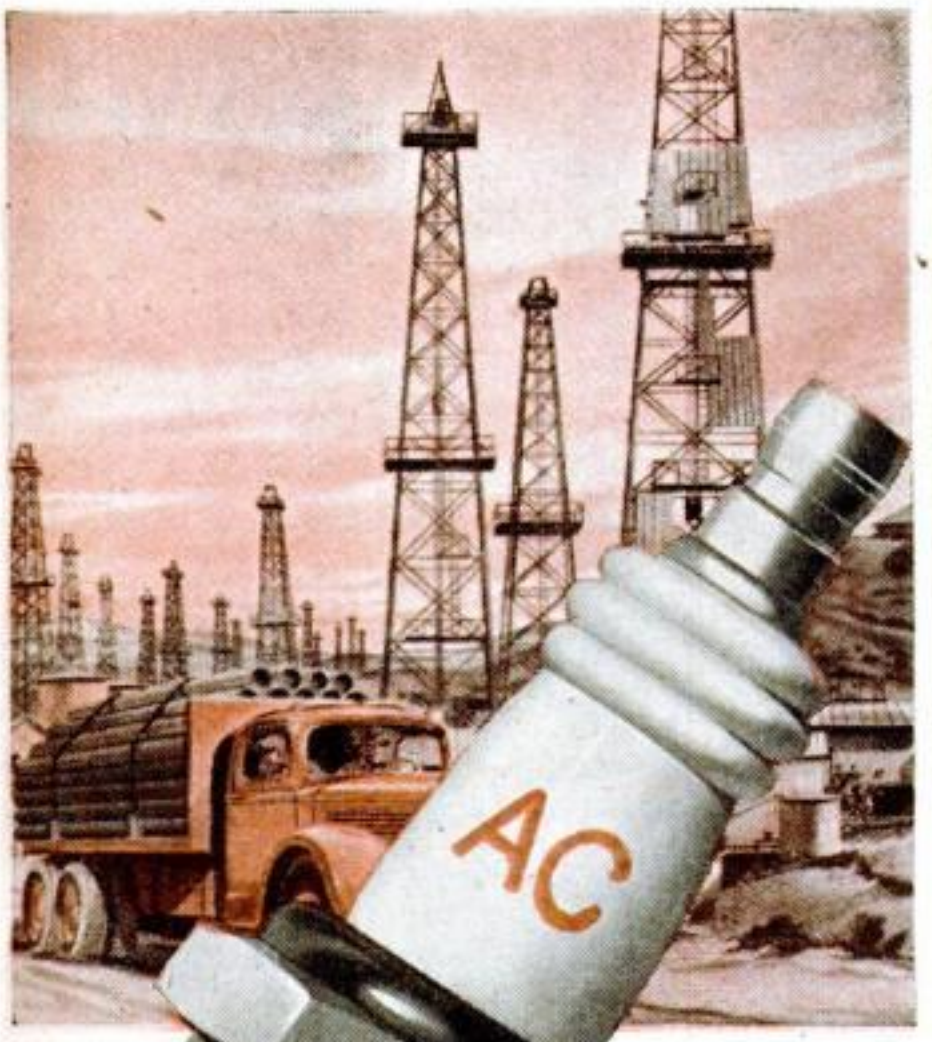
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OUTBOARD MOTORS

EVERY DOLLAR YOU INVEST HELPS SPEED VICTORY...BUY MORE BONDS

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Workers arrive at the oil fields, *on time*—oil and gasoline are trucked to their destinations, *on time*—one important reason being that many oil men, like other spark plug users, have learned to have their *spark plugs cleaned and regapped* regularly. And when new spark plugs are necessary, a very high percentage of these "motor wise" people insist upon AC's, for *utmost reliability*. For your essential driving, have your plugs cleaned and adjusted every 3,000 miles, and install new AC's—of the right Heat Range for *today's* driving—when your old plugs are worn out.



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AC

SPARK PLUGS

DON'T LET UP NOW • KEEP BUYING WAR BONDS
LET'S FINISH THE JOB

Jap Airpower

(Continued from page 73)

Col. Kingoro Hashimoto, fiery head of the central headquarters of the Imperial Rule Assistance Association, the totalitarian party, outlined the pattern of attack in a radio address: "By carrying out a suicidal crash against our objective, shall we not sink a battleship with a single plane, and shall we not force down a plane carrying ten men with a single plane?"

Radio Tokyo reports the use by the Japanese air force of a new suicide plane—"a V-1 with a pilot." With its weakness for embroidering, Tokyo said the planes were in the hands of a "special attack corps," composed of youths of 18 to 20 who were supplied with only enough fuel to reach their targets.

The Japs aren't whistling in the dark. They know that they equal us in many respects, and excel us in some.

The Zeke 52 and the U. S. Navy Hellcat are equal in range—about 1,500 miles—but the Zeke remains more maneuverable, if less speedy. Jap medium bombers are not to be sniffed at. The Betty can fly 3,200 miles without refueling. Emily, four-engine flying boat, has a top speed of almost 100 miles greater than our Consolidated Coronado, despite the fact that it weighs more and has a nine-foot-greater wing span.

The Jill torpedo bomber has a speed of 310 miles an hour, as against our Avenger's 250 plus. Frank I, a fighter, can do more than 400 miles an hour and has a range of 1,700 miles. Jack II, another fighter, is rated at about 400 m.p.h. and has a range of about 1,100 miles. Frances, medium bomber, has a top speed of about 350 miles an hour and a maximum range of 2,800 miles.

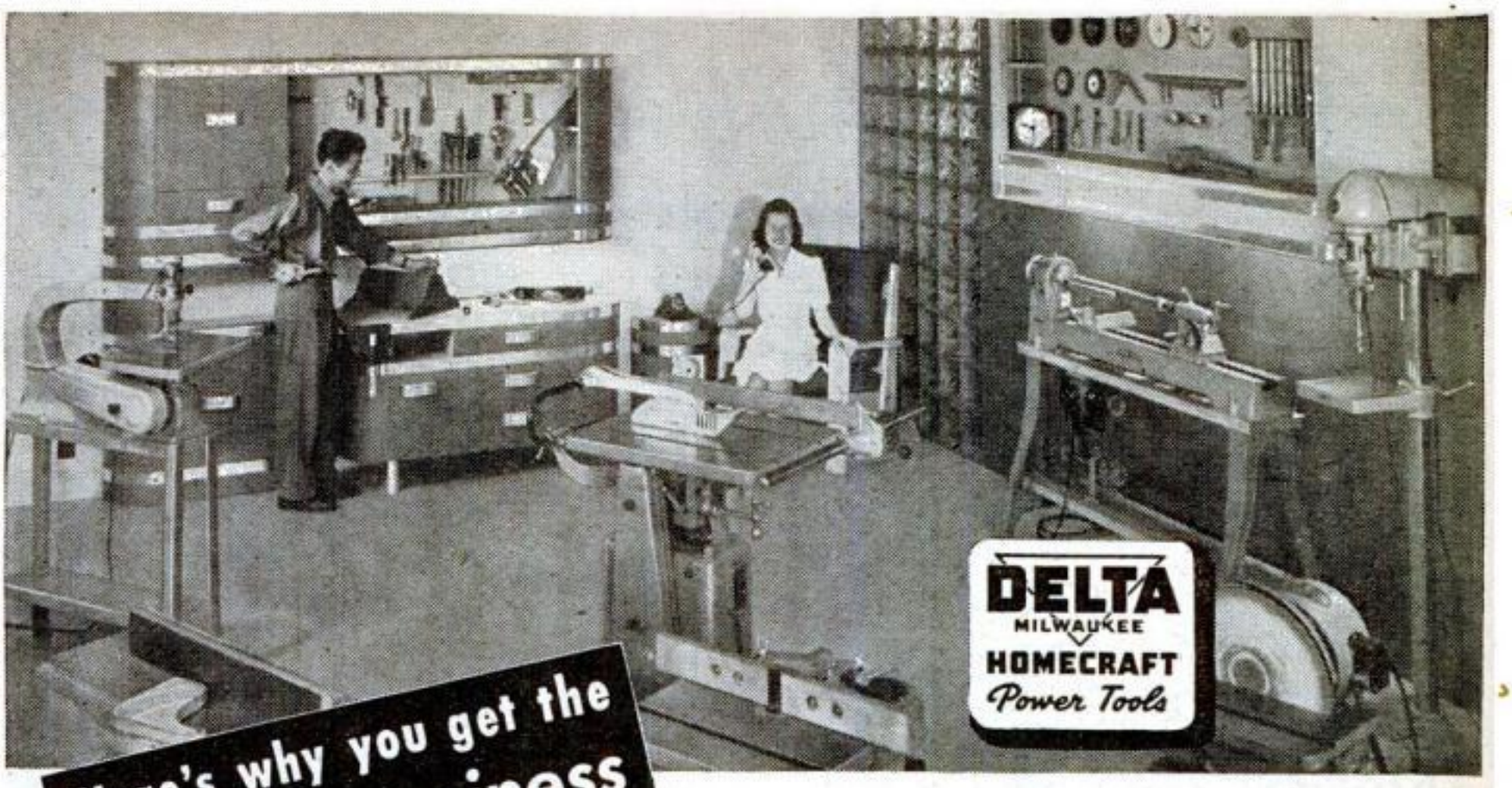
The Dinah II, army reconnaissance and light bomber manufactured by Mitsubishi, has a modern two-speed engine supercharger, can fly at a top speed of 360 miles an hour, and has a range of about 1,700 miles.

The Japs' flush riveting, designed to create cleaner wing surfaces, compares favorably with ours. The skin on the first Zekes was found to be better than anything we had produced up to that time. It enabled the enemy to use lighter supporting structures in the fuselage and wings.

Japanese aircraft designs are suited to quantity production. Tail sections are built in separate plants and joined to the fuselage at final-assembly stations. The quality of their aircraft instruments is good. In some, it is superlative.

(Continued on page 238)

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Here's why you get the most happiness from your homecraft hobby

..by enjoying the accuracy, dependability and safety of

Delta Homecraft Power Tools

Quality counts, in giving you the satisfaction you expect from the power tools you buy

There are lots of reasons why you have more homecraft happiness, when you're a Delta Homecraft Power Tool owner:

The Delta Power Tools you work with are *accurate.* And accuracy means you turn out parts that fit together according to plan, to form good-looking work you're proud of!

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They're Quality Tools!

Delta Homecraft Power Tools give you this all-around satisfaction, because of "hidden" values in construction — called *quality.*

You can't always see *quality* with your eyes, yet *quality* determines whether or not you get your money's worth!

Quality is an important reason why Delta has become the world's largest manufacturer of power tools for home use.

"Good enough" construction isn't good enough for Delta Homecraft Power Tools—it's got to be the best for the price!

Industrial-type Construction!

Examples of the quality advantages you get in various Delta Homecraft Power Tools are:

(1) *Double-sealed ball bearings* you don't have to worry about oiling, because they are *lubricated for life;*
(2) *Precision-bored bearing seats* that assure accurate alignment of parts;
(3) *Bearings that are preloaded* — an extra manufacturing operation that insures longer bearing life;
(4) *Precision-ground shafts,* to assure true, accurate performance;
(5) *Dynamically-balanced pulleys,* to cut down annoying vibration of your power tools.

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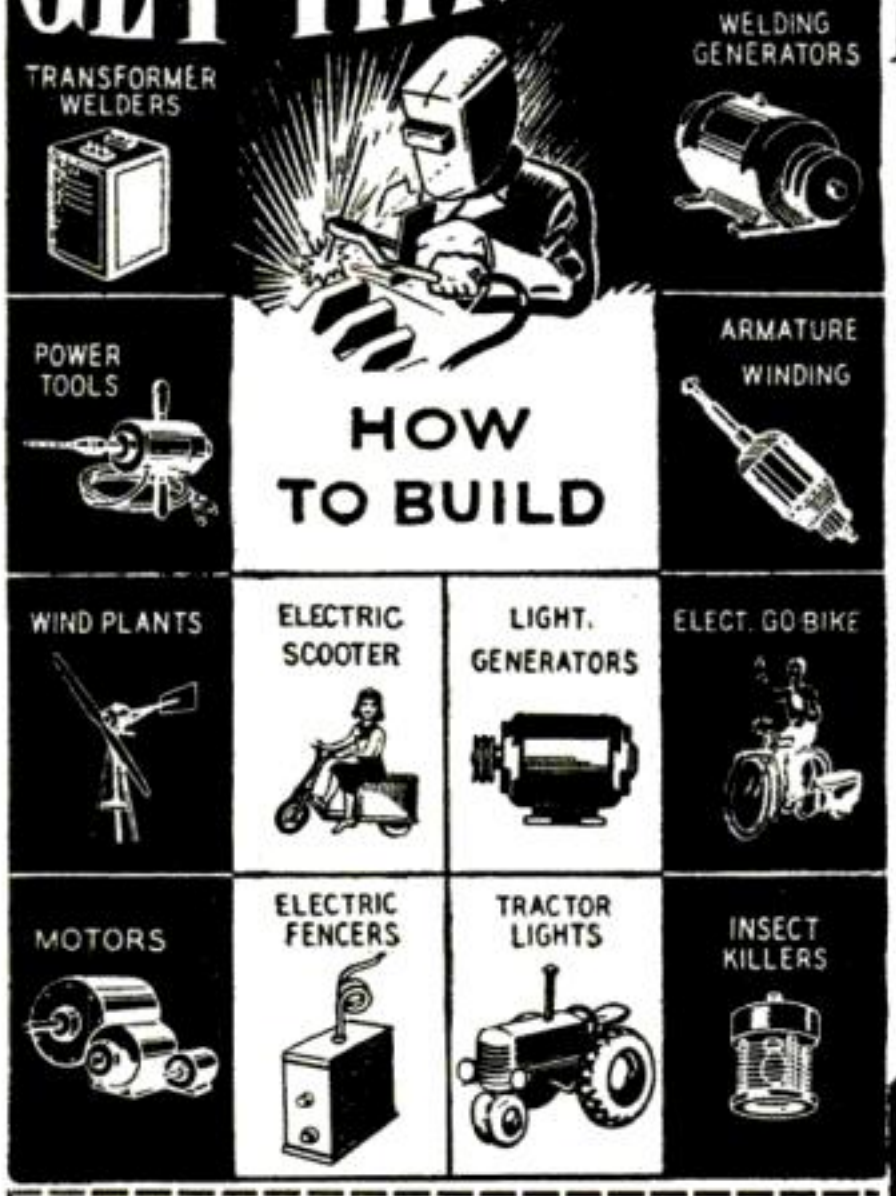
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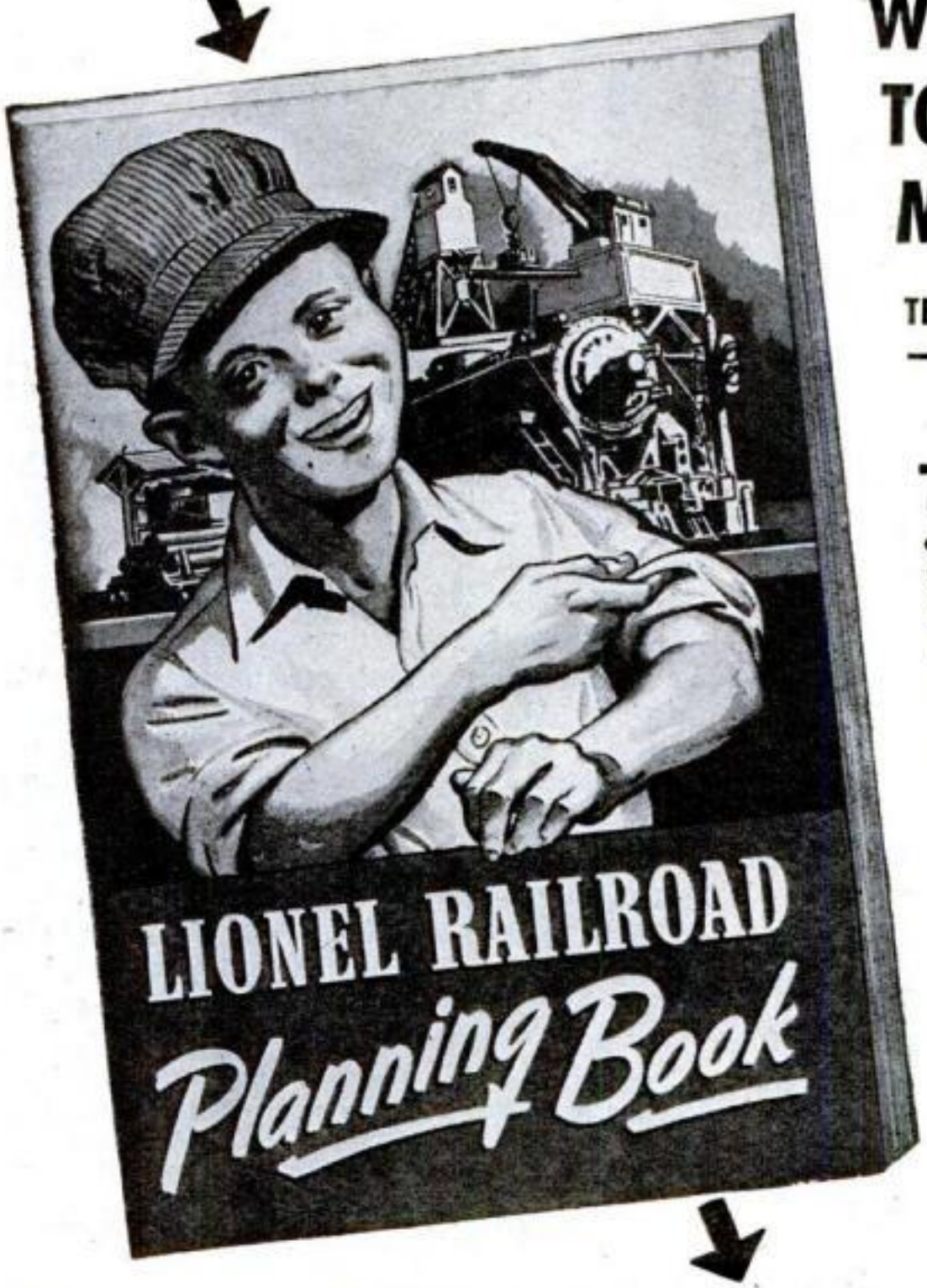
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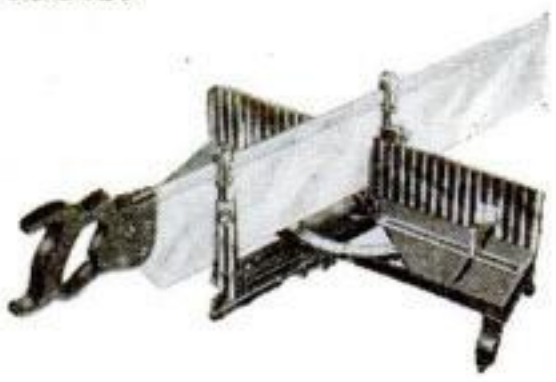
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SINCE 1868

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Jap Airpower

(Continued from page 234)

While the Japanese copied freely from us in the development of hydraulically operated variable-pitch propellers, they have supplemented them with electric propellers borrowed from the French and improved.

Japanese aeronautical research is good. It probably is a fair statement to say that it is not as good as ours. Their inability to produce a good self-sealing fuel tank is proof of it. They enclose their tanks with layers of rubber, and in some cases with layers of kapok, but a solid burst will still make sieves of them.

Jap aircraft manufacture of late has emphasized the production of high-performance interceptor fighters. The enemy knows what is coming. The vulnerability of their cities to incendiaries has been established. Nagasaki burned quite satisfactorily when incendiary clusters fell on it from the capacious bellies of our Superfortresses. Fires set in Tokyo rage for hours after the B-29's turn for home. The Jap home-defense command is moving millions of residents from 11 big population centers in anticipation of the expansion of the American air assaults.

On the evening of the day of Pearl Harbor, a too-glib American radio commentator asked: "What are the Japs trying to do, commit national suicide?"

He was four or five years too early, but he was right. Barring extraordinary political developments, Japan will die fighting.

Articles in forthcoming issues will describe Japanese seapower, tanks, and guns.

New Home and Workshop Index

YOUR index finger will itch with anticipation for a copy of our new Home and Workshop Index! All articles that have appeared from January, 1944, to and including December, 1944, on craftwork, woodworking, home building, house repairs, model making, new shop ideas, radios, and automobiles are listed alphabetically and cross-indexed for quick reference. To obtain your copy, send a dime to Popular Science Home and Workshop Index, 353 Fourth Avenue, New York 10, N. Y., enclosing a self-addressed, stamped legal-size envelope (No. 10). A limited number of 1941, 1942, and 1943 indexes are still available. Send 10 cents for each copy that you wish, and be sure to specify which year.

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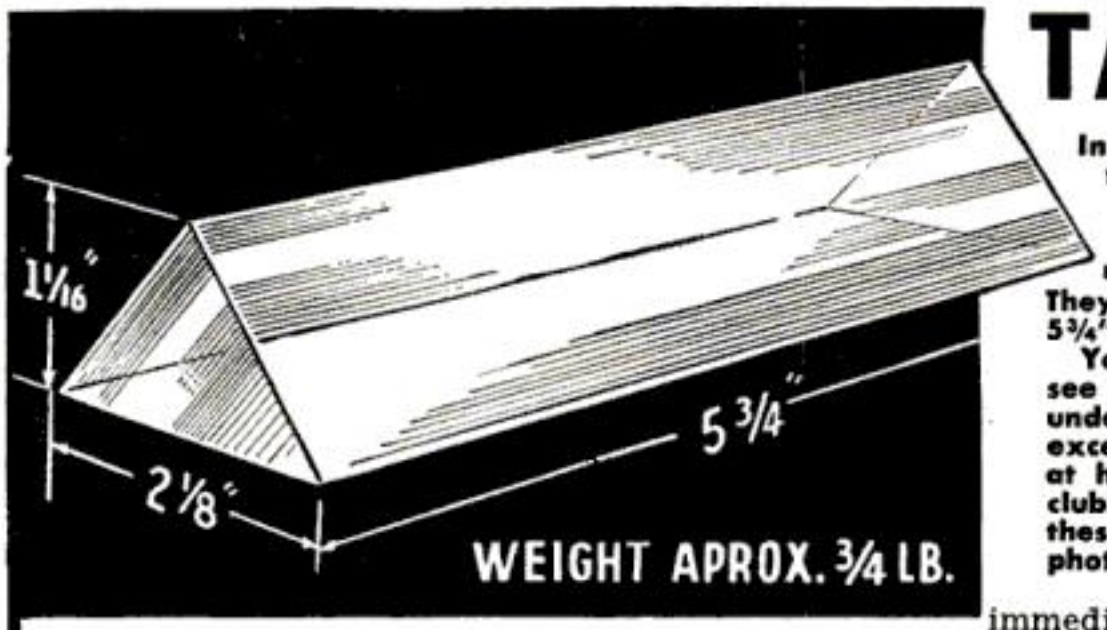
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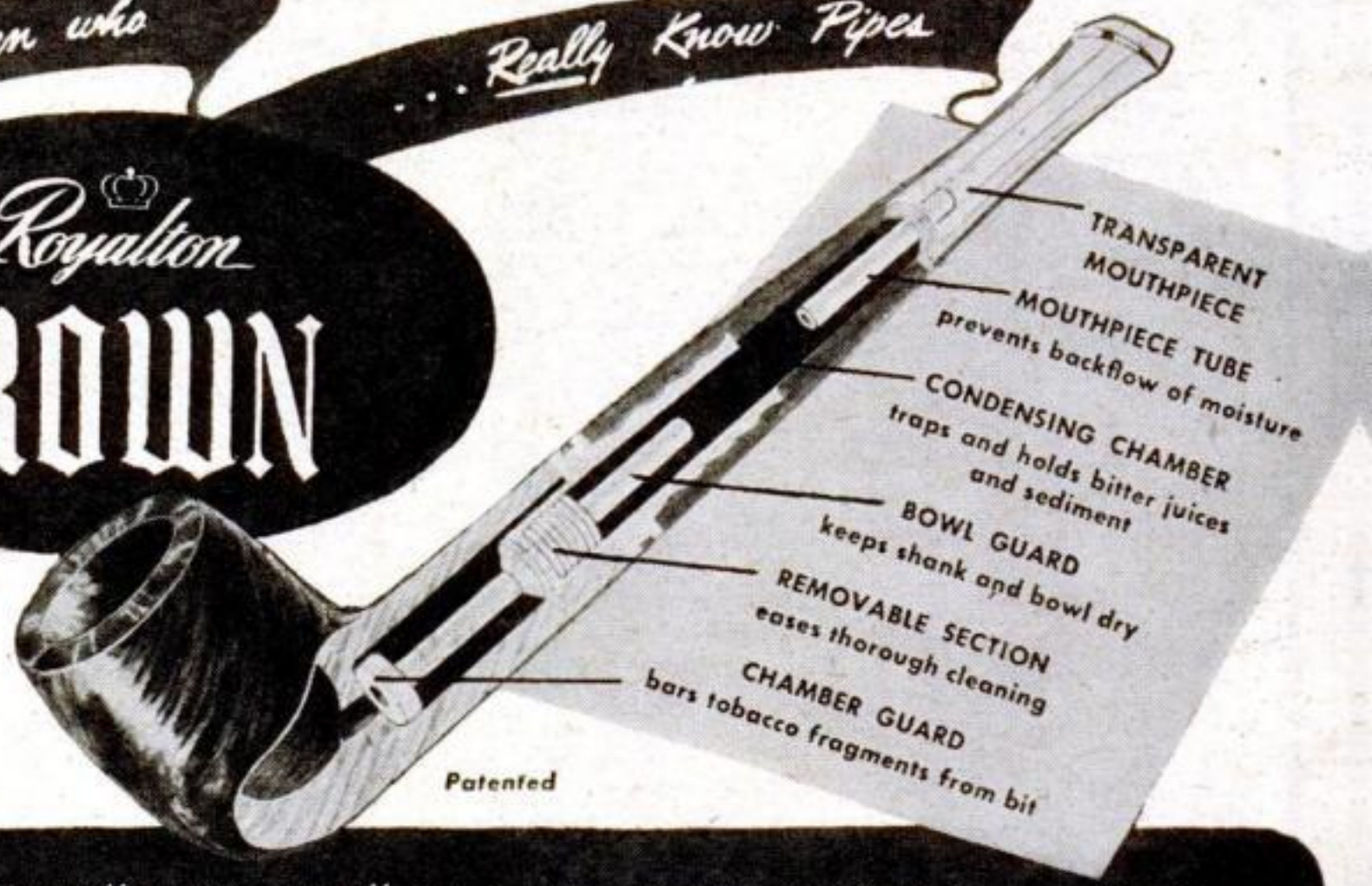
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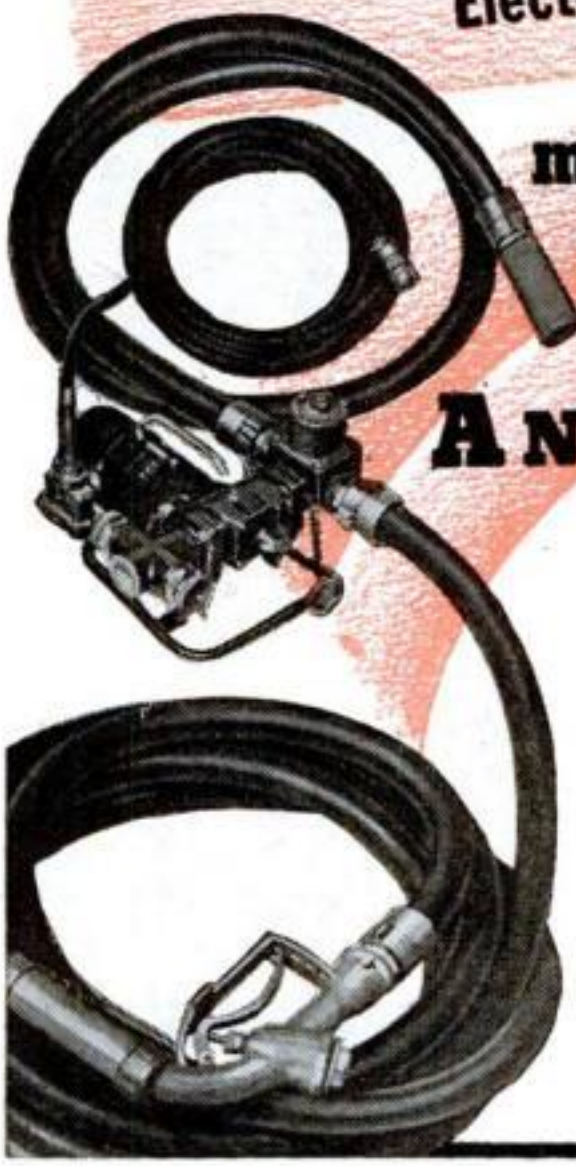
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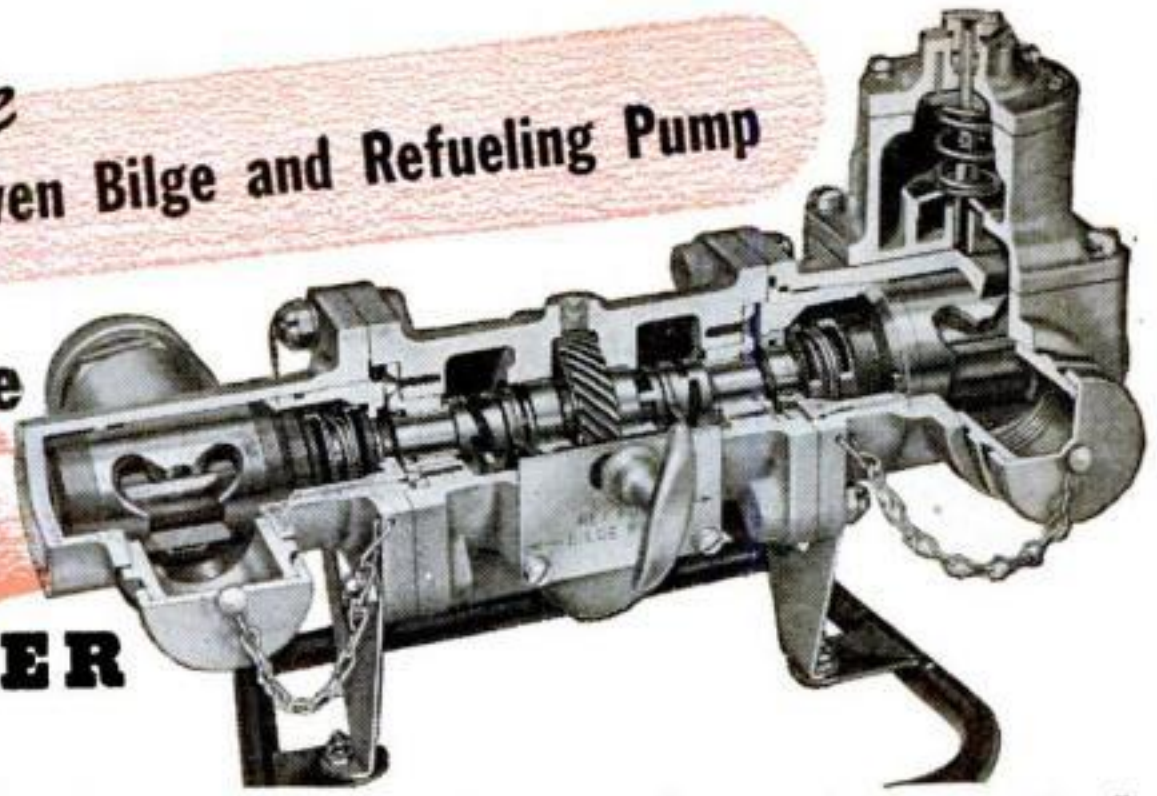
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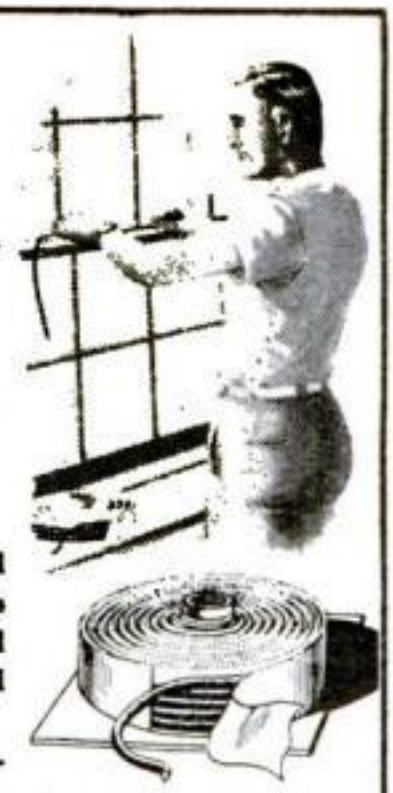
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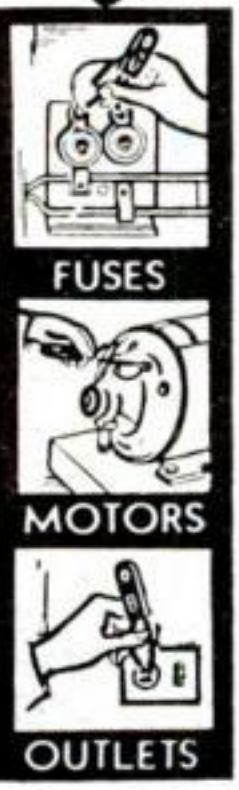
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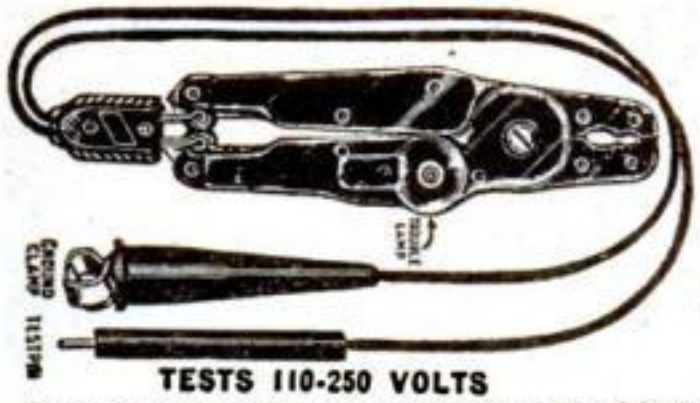
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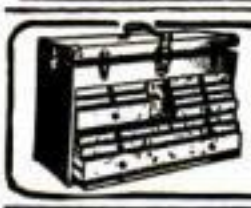
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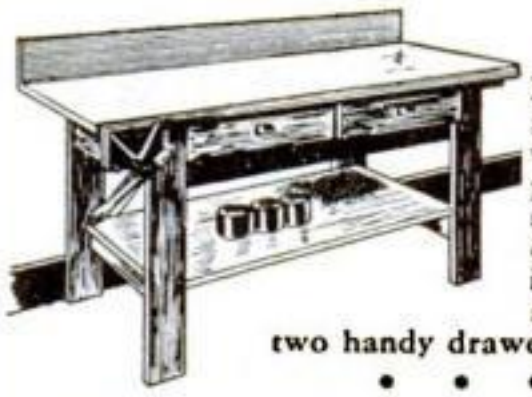
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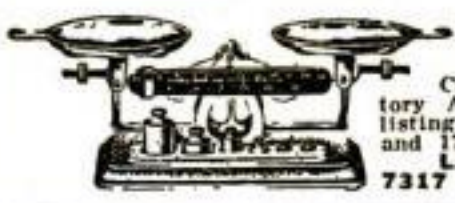


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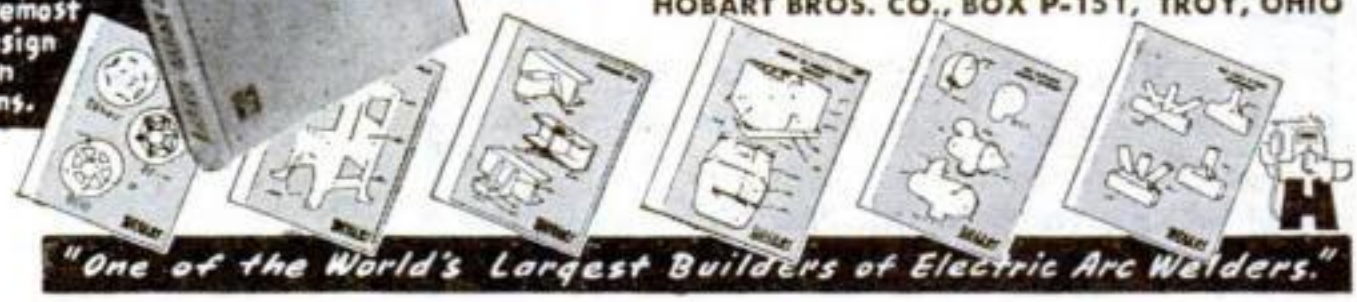
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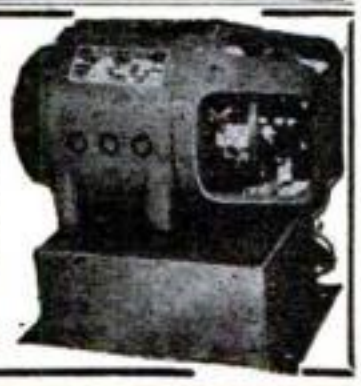


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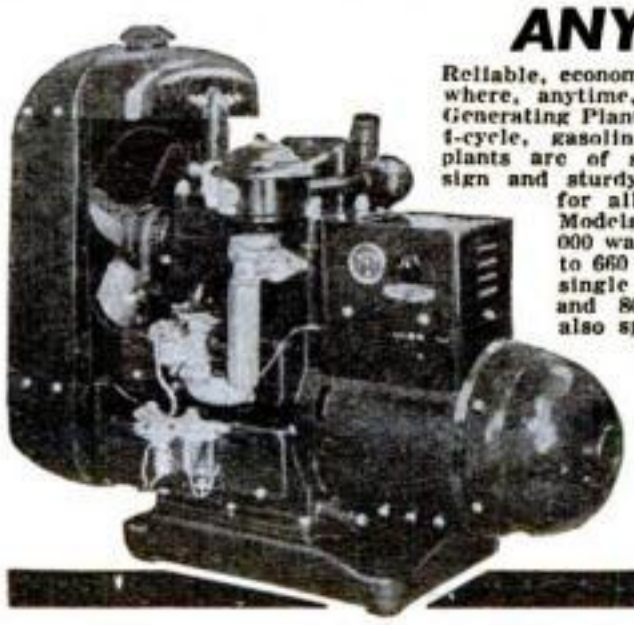
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4. Submit as many ideas as you wish, but each idea must be entered on a separate sheet or blank.

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7. Use your own stationery or write for Entry Blank.

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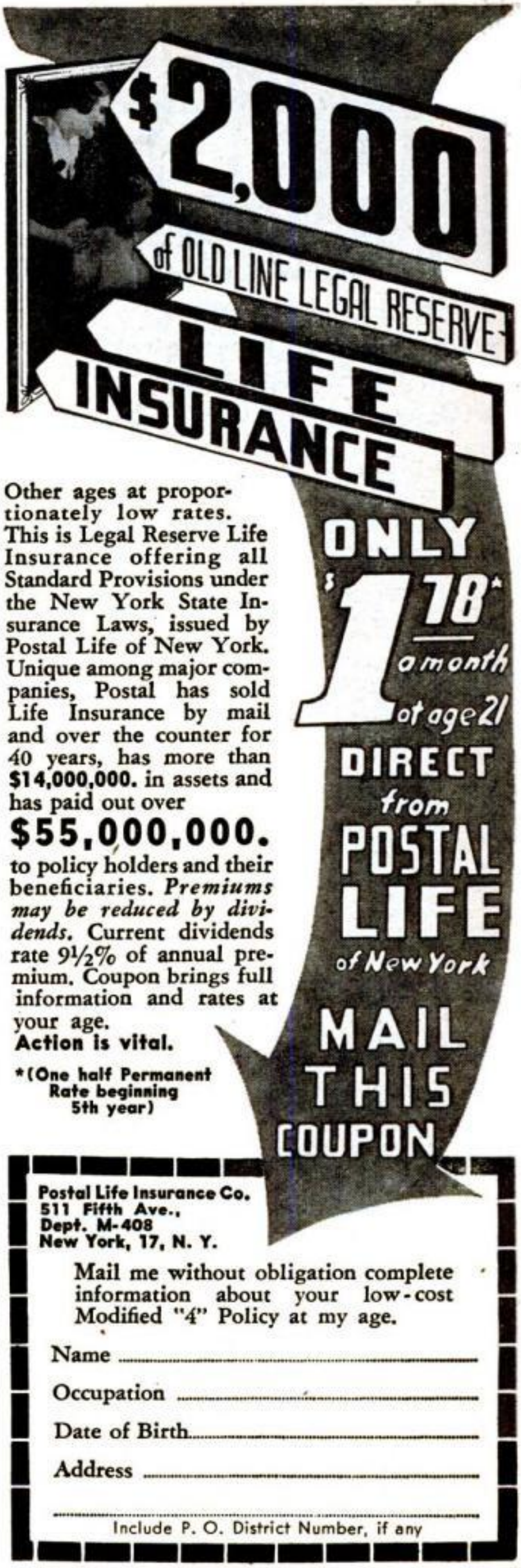
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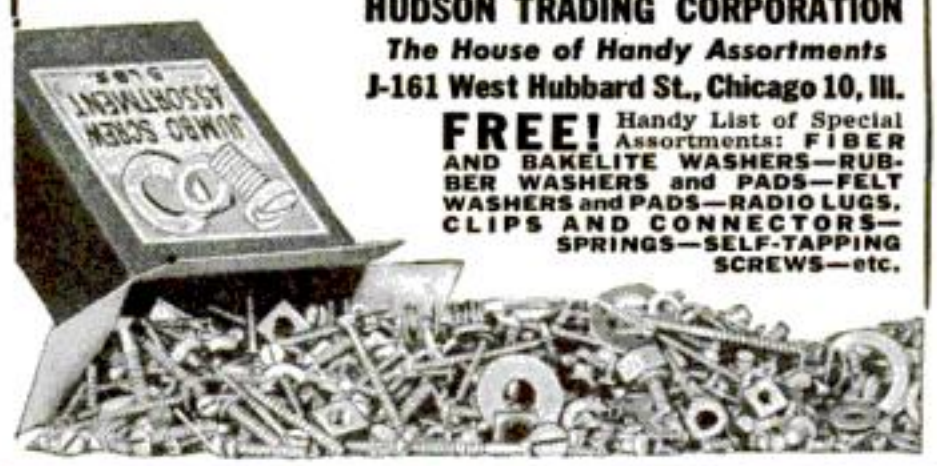
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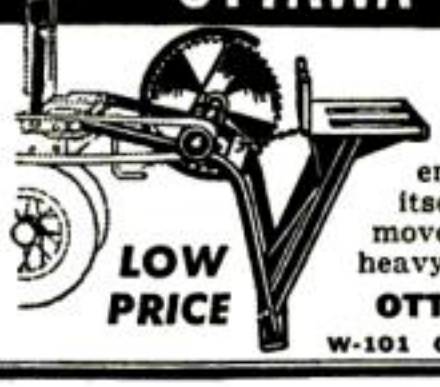


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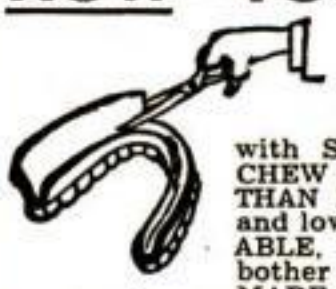
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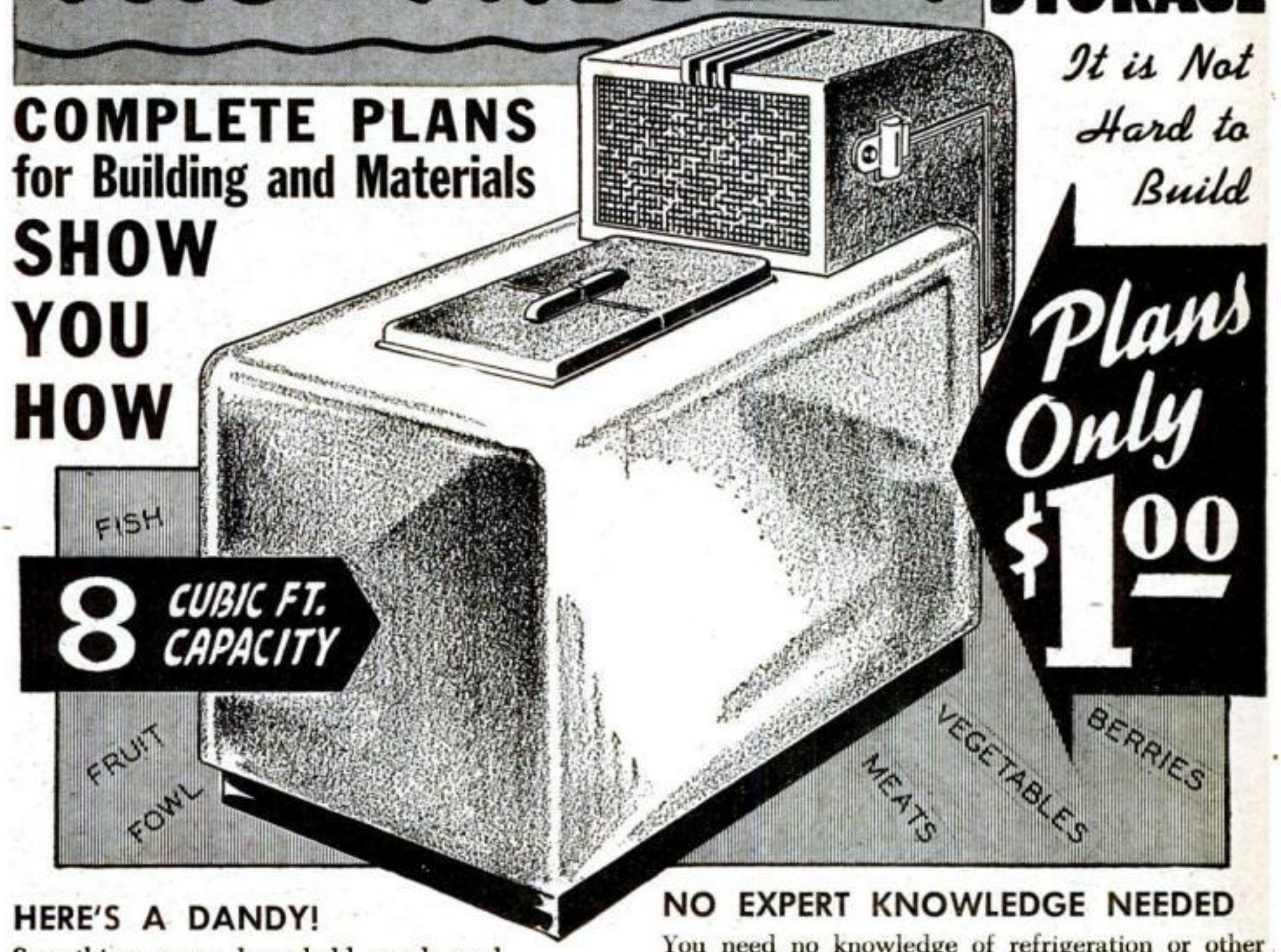
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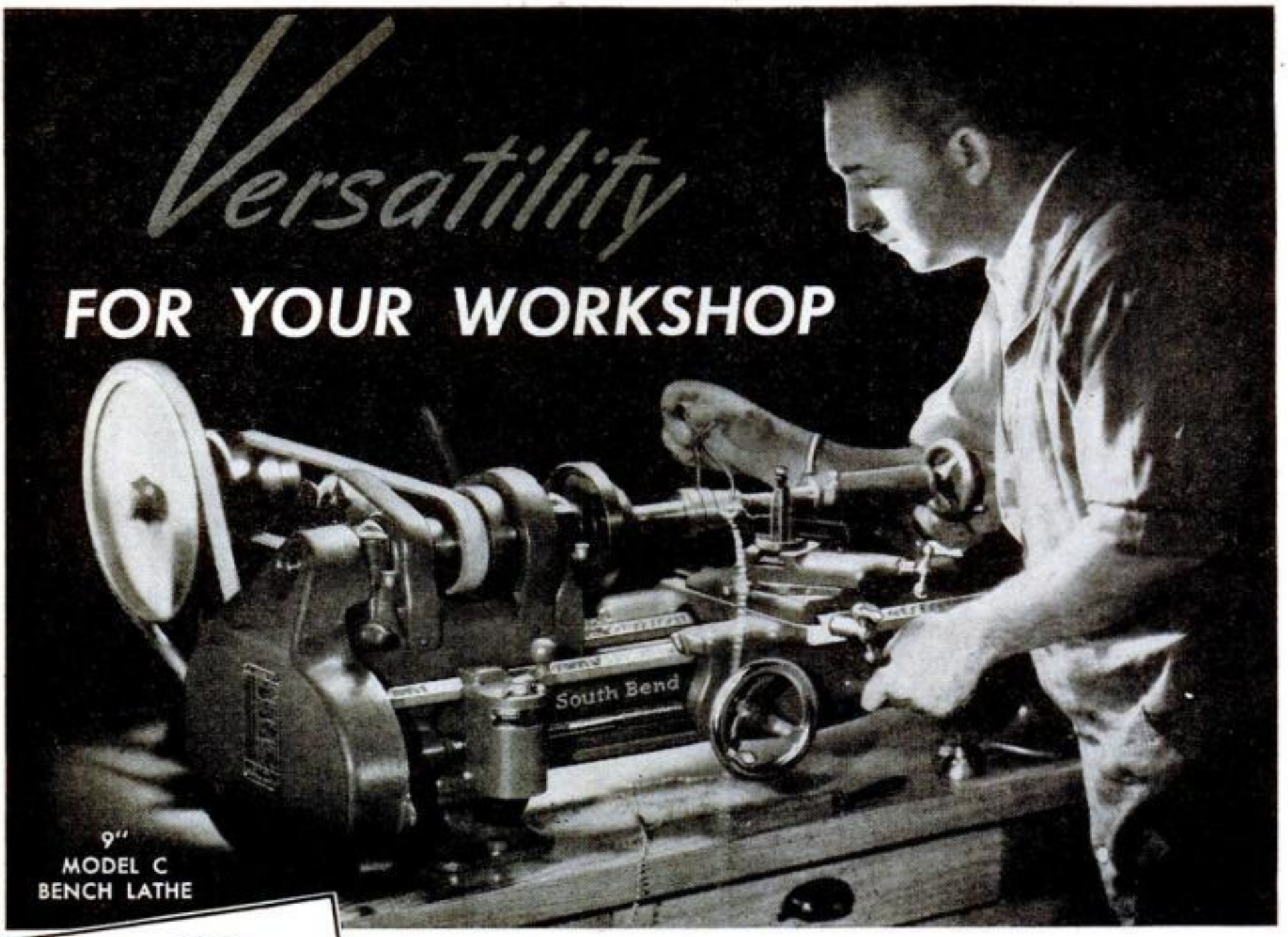
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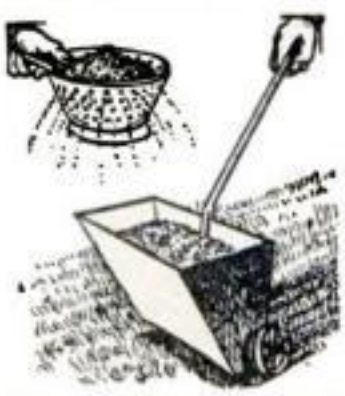
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"Okay, wise guy, but who went in and took over from there? The Army!"



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